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and hazardous alcohol use:
Longitudinal Study of Young People in England (LSYPE)**

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**Sexual orientation identity in relation to cigarette smoking and hazardous alcohol use:
Longitudinal Study of Young People in England (LSYPE)**

Running head: Sexual orientation, smoking, alcohol use.

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Abstract

Objectives. Knowledge about the health behaviours of minority groups is necessary for monitoring health inequalities. The aim of our study was to evaluate the association between lesbian, gay or bisexual (LGB) sexual orientation identity and two major health behaviours (smoking and alcohol use) in population sample of young people in the UK.

Design. Data recorded in 2006 and 2009 from the Longitudinal Study of Young People (LSYPE) prospective cohort study.

Setting. Home visits across England involving interviews with each young person and questionnaires.

Participants. Data from 6656 participants (3318) with information on sexual orientation identity (at age 18-19) and health behaviours.

Outcome measures. Smoking history, current alcohol drinking frequency and frequency of drinking alcohol to intoxication.

Results. LGB identity was reported by 3.5% of participants (55 gay, 33 lesbian, 34 bisexual male, 108 bisexual female). Adjusting for age, sex, ethnic minority status and parental socio-economic status, identification as lesbian/gay (OR = 1.57, 95% CI 1.18, 2.09) or bisexual (OR = 1.50, 95% CI 1.21, 1.86) was associated with increased risk of smoking. No association was observed for alcohol drinking frequency. Gay-identified male drinkers were twice as likely to drink to intoxication during every or most drinking episodes (OR = 2.01, 95% CI 1.28, 3.15) compared to heterosexually identified men.

Conclusions. In a sample of over 6500 young people in England, LGB identity is associated with a history of cigarette smoking. Young gay males were more likely to demonstrate

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hazardous drinking patterns. Future studies should identify mechanisms that explain these associations.

Key words: Alcohol Drinking, Alcoholic Intoxication, Cigarette Smoking, Cohort Studies, Sexuality.

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Article summary

Article focus

- Studies, mainly from the US, have found an association between lesbian, gay or bisexual (LGB) sexual orientation and cigarette smoking
- LGB orientation may be associated with hazardous alcohol drinking, although previous results are mixed

Key messages

- LGB orientation is associated with higher rates of smoking history in a population sample of English 18-19 year-olds
- For men at age 18-19, gay identity is associated with alcohol intoxication on every or most drinking episodes
- Recording sexual orientation is necessary for describing health inequalities and among young people, there is a very low refusal rate (0.1%)

Strengths and limitations of this study

- This is the first cohort study in the UK to record sexual orientation identity
- Smoking history but not current smoking status was recorded at age 18-19
- Alcohol drinking frequency but not quantity was measured

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Introduction

Knowledge about the health behaviours of sexual minority groups is necessary for monitoring health inequalities, developing public health policies, allocating resources and targeting high risk groups for interventions¹⁻³. It is estimated that between 1.5%⁴ and 5%⁵ of the UK population are lesbian, gay, or bisexual (LGB). Estimates vary depending on whether identity, attraction, or sexual behaviour is used as to define sexual orientation⁶⁻⁸.

Additionally, estimates are found to vary by age and ethnic group⁴. Relatively few research studies include a measure of sexual orientation, particularly in the UK. Exceptions include the ONS Integrated Household Survey⁴ and the Longitudinal Study of Young People in England⁹ which both included the question for the first time in 2009. As a result, the evidence base on health inequalities for LGB groups is very sparse.

Cigarette smoking remains a prevalent behaviour among young people¹⁰. Many studies have shown an association between LGB orientation and cigarette smoking, particularly in the US¹¹⁻¹⁹ but also in different countries²⁰⁻²². The association appears to be robust, appearing in men and women and in different age groups, with some exceptions^{21 23-25}. Occasionally the association is found to be stronger in women^{21 23-25}. Some of the studies used sexual orientation identity as a measure of sexual orientation^{12 23 24}, some used same-sex attraction^{17 25} and some used multiple measures³.

Evidence supporting an association between LGB identity and alcohol use is more mixed, with evidence for possible effect modification by sex. Several studies have found an association among lesbian/bisexual women (hereafter, LB women) compared to heterosexual women for greater alcohol intake²⁵⁻²⁷, alcohol dependence²⁸, and hazardous alcohol drinking such as drunkenness and binge drinking^{14 21 29-31}. These associations have been found among adolescents in the transition to early adulthood^{14 25 27}, among University students³⁰, in

midlife²⁶, across the adult age range^{21 28 29 31}, when using behavioural definitions of sexual orientation²² and in different countries including Mexico²⁰ and the UK^{21 22 25 29}. A systematic review found increased risk of alcohol dependence in men and women and an association between LB identity and alcohol misuse in women only³. Studies reporting an association between gay/bisexual male (hereafter, GB men) identity and heavier alcohol use are fewer, with one finding an association specific to those under 50¹⁹. There is evidence of a higher prevalence of heavy and potentially hazardous alcohol use among GB men recruited from recreational spaces, gay pride events and web surveys^{32 33}.

The aim of our study was to estimate the association between LGB orientation identity and cigarette smoking history, frequency of alcohol use and frequency of drinking alcohol to intoxication, from a population sample of young people (age 18-19) in England in 2009.

Methods

The Longitudinal Study of Young People in England (LSYPE) is a prospective cohort study of English school pupils with repeated annual follow-ups⁹. At recruitment in 2004, participants (N = 15,770) were typically aged 13-14. The cohort was created to evaluate the transitions made by young people from secondary and tertiary education into adulthood. Pupils and parents were invited to participate by letter, using databases of schools to identify potential participants. Schools were defined as socio-economically deprived if they fell within the worst quintile of schools ranked according to the proportion of pupils in receipt of school meals. Deprived schools were over-sampled by a factor 1.5 and ethnic minority groups to N=1000 per group. Annual home interview visits incorporated a computer-assisted self-completion element, including questions about smoking (most recently in 2006, typical age 15/16), alcohol consumption and sexual orientation identity (both in 2009, age 18/19). In 2009, participants were offered either a home visit, telephone interview or web questionnaire.

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3 *Sexual orientation identity.* Sexual orientation identity was measured in 2009 using the
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5 question ‘Which of the following best describes how you think of yourself?’ for the web
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7 questionnaire (N = 2690, 40.4%), and the question ‘I will now read out a list of terms people
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9 sometimes use to describe how they think of themselves: Heterosexual or straight; Gay or
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11 lesbian; Bisexual, Other. As I read the list again please say ‘yes’ when you hear the option
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13 that best describes how you think of yourself’ for the home visit (N = 848, 12.7%) and
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15 telephone interview (N = 3118, 46.8%). These response options are recommended by the
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17 Office of National Statistics ⁴. The refusal rate for this question was 0.1%, with 0.3%
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19 reporting ‘Other’.
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24 *Regular cigarette smoking.* Cigarette smoking was last measured in 2006 with the question
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26 ‘Do you ever smoke cigarettes at all?’ followed by six response options (I have never
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28 smoked, I have only ever tried smoking once, I used to smoke sometimes but I never smoke a
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30 cigarette now, I sometimes smoke cigarettes now but I don't smoke as many as one a week, I
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32 usually smoke between one and six cigarettes a week, I usually smoke more than six
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34 cigarettes a week). These were grouped into smoker (sometimes or weekly smoking) versus
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36 non-smoker.
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40 *Weekly alcohol drinking.* Alcohol drinking was measured in 2009 using the question
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42 ‘Thinking about the last 12 months, about how often did you usually have an alcoholic
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44 drink?’ with seven response options (Almost every day, Five or six days a week, Three or
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46 four days a week, Once or twice a week, Once or twice a month, Once every couple of
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48 months, Once or twice a year). Responses were grouped into ‘weekly’ versus ‘less than
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50 weekly’ categories.
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54 *Hazardous alcohol drinking.* Hazardous alcohol drinking was measured in 2009 in response
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56 to a question about alcohol intoxication frequency, ‘On those days when you did have an
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alcoholic drink, how often would you say you got drunk?’ followed by six response options (Every time, Most times, Around half the time, Less than half the time, Rarely, Never).

Hazardous alcohol drinking was defined as reporting drunkenness every/most of the time, among weekly alcohol drinkers.

Demographic covariates. Age and sex were recorded at baseline in 2004. Pupils self-reported their ethnic group and responses were grouped into five categories: White, Mixed, Indian/Pakistani/Bangladeshi, Black Caribbean/Black African, Chinese. The maximum of either parent’s educational attainment was recorded on a six-point scale ranging from ‘no qualification’ (0) to ‘degree or equivalent’ (6). Occupational social class was recorded on an eight-point scale ranging from ‘never worked or long term unemployed’ (1) to ‘higher managerial and professional occupations’ (8), for one or both parents.

Statistical analysis. For descriptive analyses, chi-square tests were used to identify significant differences for gay/bisexual vs. heterosexual participants for each study variable. Linear trends were evaluated using logistic regression with heterosexual, bisexual and gay/lesbian categories entered into the model as a continuous parameter. Logistic regression was used to identify whether the mode of survey administration (home visit, telephone interview or web questionnaire) influenced reporting of LGB identity. For the main analysis, logistic regression was used to calculate odds ratios that summarized the relative risk of cigarette smoking, weekly alcohol drinking and hazardous alcohol drinking among weekly alcohol drinkers, according to sexual orientation identity (gay vs. heterosexual and bisexual vs. heterosexual). We minimally adjusted the odds ratios for age and ethnic minority status, and then additionally adjusted the estimates for parental education and social class. Possible effect modification by sex, parental occupation, parental education and mode of survey administration (home visit, telephone interview, web survey) was evaluated by including interactions between sexual orientation and the possible effect modifier and conducting

global tests of interaction. In supplementary analyses, we also combined gay/lesbian and bisexual into a single 'LGB' category. Sample weights were used to obtain correct standard errors, allowing for over-sampling of schools with low socio-economic status and for ethnic minority pupils at recruitment. All analyses were performed in Mplus version 7.0.

Results

The analytic sample comprised 6656 participants with data on sexual orientation identity, smoking status and alcohol use in addition to covariates. In preliminary analyses, we found no significant interaction between sexual orientation identity and either sex or parental SES for smoking and alcohol drinking, leading us to analyse males and females together. For hazardous drinking among alcohol drinkers however, there was a significant interaction with sex. Models for hazardous drinking were therefore conducted separately for males and females. So that non-drinkers could be excluded from analyses of alcohol drinking patterns, a nested sample of 2371 male and 2056 female weekly alcohol drinkers was also used.

Compared to at recruitment, the analytic sample contained slightly fewer men (49.7% vs. 53.4%, $p < 0.001$), fewer ethnic minorities (6.6% vs. 17.8%, $p < 0.001$) and fewer participants with low parental occupational social class (40.5% vs. 51.9%, $p < 0.001$), fewer participants with low levels of parental educational attainment (15.2 vs. 30.3%, $p < 0.001$)

Unweighted descriptive statistics for study variables are shown in Table 1. A total of 3.5% were classified as lesbian, gay or bisexual (55 gay men, 33 lesbian women, 34 bisexual men, 108 bisexual women, 3229 heterosexual men, 3197 heterosexual women). There were a lower proportion of lesbian women (37.5%) compared to gay men (37.5%), but a higher proportion of bisexual women (76.1%) than gay men (23.9%). Lesbian/gay participants were significantly more likely to report a cigarette smoking history and a hazardous alcohol drinking pattern. A non-significant trend was observed for regular alcohol drinking. There

were no significant differences according to ethnic minority status or parental socio-economic status. A significant linear trend was observed however across heterosexual, bisexual, gay/lesbian categories for ethnic minority respondents, who were least likely to endorse LGB response options. Significant linear trends were also observed for cigarette smoking and drunkenness, and a non-significant trend for regular alcohol drinking. Compared to the web survey, participants completing the telephone interview were more likely to report heterosexual compared to LGB identity (OR = 1.55, 95% CI 1.16, 2.06). There were no significant differences in reporting heterosexual identity between the home visit and the web survey (OR = 1.16, 95% CI 0.77, 1.73). In supplementary descriptive analyses (not shown) using sample weights to adjust for the complex survey design, the proportion of participants classified as LGB increased marginally to 3.7% (95% CI 3.2% to 4.2%).

Results from logistic regression analyses are shown in Table 2, minimally adjusted for age, sex and ethnic minority status and then after further adjustments for parental educational attainment and occupational social class. The results are weighted to allow for over-sampling at recruitment. Identification as gay/lesbian was associated with increased odds of smoking (OR = 1.57, 95% CI 1.18, 2.08) which was little affected by further adjustment for parental SES (OR = 1.57, 95% CI 1.18, 2.09), likely reflecting the lack of association between sexual orientation and SES (Table 1). Identification as bisexual was also associated with smoking (OR = 1.49, 95% CI 1.20, 1.84) which remained after further adjustment (OR = 1.50, 95% CI 1.21, 1.86). In models combining gay/lesbian with bisexual categories, identifying as LGB was associated with smoking (OR = 1.52, 95% CI 1.27, 1.81) which was unchanged after further adjustment (OR = 1.52, 95% CI 1.28, 1.82). In supplementary analyses (not shown), the mode of survey administration was not found to modify the association (p for global interaction > 0.05).

Men and women were separated for analysis of alcohol drinking, because sex was found to modify the association between sexual orientation identity and alcohol use. Weekly alcohol drinking was not associated with lesbian identity in women (OR = 1.12, 95% CI 0.81, 1.57) or bisexual identity (OR = 1.00, 95% CI 0.79, 1.26), including after further adjustment for parental SES. Among male weekly alcohol drinkers however, gay (OR = 2.00, 95% CI 1.27, 3.15) and bisexual (OR = 2.00, 95% CI 1.17, 3.44) identities were associated with hazardous alcohol drinking patterns. The association remained for gay identity following adjustment for parental SES (OR = 2.01, 95% CI 1.28, 3.15) but was no longer significant for bisexual identified males (OR = 0.90, 95% CI 0.67, 1.25). There was no significant effect modification by the mode of survey administration (p for global interaction > 0.05). A combined LGB category had no association with hazardous drinking (OR = 1.01, 95% CI 0.87, 1.35). Among female weekly alcohol drinkers, there was no association between lesbian (OR = 0.92, 95% CI 0.55, 1.55) or bisexual (OR = 0.92, 95% CI 0.67, 1.25) or combined LGB (OR = 0.93, 95% CI 0.70, 1.23) identity and hazardous drinking. There was little change in these estimates after additional adjustment for parental SES.

Discussion

In a community-dwelling sample of over 6500 young adults in England, men and women reporting a gay/lesbian or bisexual (LGB) identity were around 50% more likely to have a history of cigarette smoking than those reporting a heterosexual identity at age 18-19. No association was observed between LGB heterosexual identity and current weekly alcohol drinking (for men and women). Among male weekly alcohol drinkers however, identifying as gay/bisexual was associated with a two-fold increase in the likelihood of a hazardous alcohol drinking pattern, defined as drinking to intoxication on every/most drinking occasions. There was no association between lesbian identity and hazardous alcohol drinking.

Strengths of the study include the large sample which was representative of an entire school year in England at recruitment in 1990/91. Data from the UK on sexual orientation identity are exceptionally rare, particularly for young cohorts^{22 28}. Around 3% of this cohort identified as LGB. The refusal rate for the sexual orientation identity question was low, particularly in the web survey, and differences in how this question was administered were not found to influence results materially. Several major cohort studies in the US^{31 34} have included questions on sexual orientation identity in recent years. In the UK, data on health inequalities in LGB identified adults has historically come from cross-sectional surveys recruited using snowball sampling²⁹, gay pride events and internet surveys³³ which do not address issues of representativeness fully, even when a heterosexual control group is available²⁹. Recruitment from recreational spaces, particularly before the smoking ban, may have introduced bias into earlier studies. To our knowledge, this the first study to demonstrate that sex modifies the association between sexual orientation identity and drinking alcohol to intoxication in a young UK cohort. The long-demonstrated association between LGB orientation and smoking^{3 35-37} appears to have persisted.

A clear limitation of our study was that smoking status was last assessed in 2006, two years before sexual orientation was last recorded. Participants may have changed their sexual orientation identity³⁰ or smoking status between 2006 and 2009, and so the data only allow the association with a smoking history to be evaluated. Smoking is not known to influence sexual orientation identity, and so we are not concerned about possible reverse causation. It is worth noting however, that young people who begin smoking tend to continue into adulthood³⁸ and two-thirds of smokers begin before age 18¹⁰. Second, statistical power may not have been available to detect smaller associations, owing to the relatively small proportion of participants in sexual minority groups. A second limitation was that aspects of sexual orientation other than identity such as attraction and behaviours^{8 24 39}, were not recorded.

Although our finding that LGB orientation is associated with smoking is largely consistent with other studies, the results concerning drinking alcohol to intoxication differ from prior reports. In several US studies, the association between LGB identity and hazardous alcohol use tends to be stronger among LB women^{14 21 29-31} and in a systematic review, LB identity in women was associated with alcohol dependence and misuse; misuse defined as >21/14 units/week in men/women³. It is important to emphasize however that our study measured alcohol drinking frequency and frequency of drinking to intoxication, not dependence or misuse. Studies from the US involving younger cohorts have reported associations with hazardous alcohol drinking for LGB men and women^{27 30}. Environmental differences between the UK and US could influence the behaviours of adults who identify as LGB. Such influences might include the age of consent, legal drinking age, laws concerning discrimination, availability of social support and recreational spaces for socializing. Future international comparisons are necessary.

It is important to identify the underlying mechanisms that connect LGB identity to health behaviours. We are not aware of evidence for genetic covariance between sexual orientation identity and health behaviours, and suggest that sexual orientation itself is unlikely to cause smoking and alcohol use. Several possible mechanisms have been proposed and require further study, most of which remain theoretical. The concept of 'minority stress'²⁸ is often invoked to explain how heterosexism and homophobia are internalised, perhaps leading people to self-medicate psychological distress with cigarettes or alcohol²⁷. Alternatively, LGB young people may socialize or have socialized in recreational spaces where cigarettes and alcohol are easily available, where peer norms encourage engagement in these behaviours³⁰, to appear older than their true age, or to signify a sexual preference involving tobacco. Concern with appearance could motivate smoking as a weight management strategy. Other commentators have noted the role of the tobacco industry in targeting LGB smokers⁴⁰.

Early unhealthy behaviours among LGB young people may influence trajectories toward chronic disease in later life ^{14 25}. Longitudinal repeated measures data will be necessary in order to identify the antecedents and consequences of unhealthy behaviours for LGB young people in the UK, across the life course.

Despite recent equality and diversity legislation and the inclusion of sexual orientation in the National Health Service (NHS) Equality Delivery System, sexual orientation identity is rarely monitored by NHS organisations or measured in epidemiological studies. To improve the evidence base, and support international comparisons, data about sexual orientation should be collected routinely ¹⁻³. Questions about sexual orientation can be added at low cost and have relatively low refusal rates, particularly among young people. Wider measurement of sexual orientation would ultimately help reduce health inequalities.

Author contributions

Isla Fitchie conducted the literature review. Gareth Hagger-Johnson performed the analyses. All authors contributed to writing the manuscript.

Data sharing statement

Data are available from the UK Data Archive. Syntax to reproduce the results presented here is available from the corresponding author on request.

References

1. McCabe SE, Hughes TL, Bostwick W, Morales M, Boyd CJ. Measurement of Sexual Identity in Surveys: Implications for Substance Abuse Research. *Archives of Sexual Behavior* 2012;41(3):649-57.
2. Dilley JA, Simmons KW, Boysun MJ, Pizacani BA, Stark MJ. Demonstrating the Importance and Feasibility of Including Sexual Orientation in Public Health Surveys: Health Disparities in the Pacific Northwest. *American Journal of Public Health* 2010;100(3):460-67.
3. King M, Semlyen J, Tai S, Killaspy H, Osborn D, Popelyuk D, et al. A systematic review of mental disorder, suicide, and deliberate self harm in lesbian, gay and bisexual people. *BMC Psychiatry* 2008;8(1):70.
4. Office of National Statistics. Measuring Sexual Identity: An Evaluation Report. London, 2010.
5. Johnson AM, Mercer CH, Erens B, Copas AJ, McManus S, Wellings K, et al. Sexual behaviour in Britain: partnerships, practices, and HIV risk behaviours. *The Lancet* 2001;358(9296):1835-42.
6. Bostwick WB, Boyd CJ, Hughes TL, McCabe SE. Dimensions of Sexual Orientation and the Prevalence of Mood and Anxiety Disorders in the United States. *American Journal of Public Health* 2010;100(3):468-75.
7. Corte C, Matthews A, Kuhn L, Garofalo R, Bird J, Johnson A. Dimensions of sexual identity development and alcohol and drug-related risk behavior in sexual minority men. *Alcoholism-Clinical and Experimental Research* 2010;34(6):241A-41A.
8. McCabe SE, Hughes TL, Bostwick W, Boyd CJ. Assessment of difference in dimensions of sexual orientation: Implications for substance use research in a college-age population. *Journal of Studies on Alcohol* 2005;66(5):620-29.
9. Service EaSD. Longitudinal Study of Young People in England: Waves One to Seven. In: ESDS, editor. Colchester, 2011.
10. Health and Social Care Information Centre. Statistics on smoking: England 2010. London: National Health Service,, 2011.
11. Tang H, Greenwood GL, Cowling DW, Lloyd JC, Roeseler AG, Bal DG. Cigarette smoking among lesbians, gays, and bisexuals: how serious a problem? (United States). *Cancer Causes Control* 2004;15(8):797-803.
12. Gruskin EP, Gordon N. Gay/Lesbian sexual orientation increases risk for cigarette smoking and heavy drinking among members of a large Northern California health plan. *BMC Public Health* 2006;6.
13. Gruskin EP, Greenwood GL, Matevia M, Pollack LM, Bye LL. Disparities in smoking between the lesbian, gay, and bisexual population and the general population in California. *Am J Public Health* 2007;97(8):1496-502.
14. Marshal MP, Friedman MS, Stall R, Thompson AL. Individual trajectories of substance use in lesbian, gay and bisexual youth and heterosexual youth. *Addiction* 2009;104(6):974-81.
15. Hatzenbuehler ML, Wieringa NF, Keyes KM. Community-level determinants of tobacco use disparities in lesbian, gay, and bisexual youth: results from a population-based study. *Arch Pediatr Adolesc Med* 2011;165(6):527-32.
16. Pizacani BA, Rohde K, Bushore C, Stark MJ, Maher JE, Dilley JA, et al. Smoking-related knowledge, attitudes and behaviors in the lesbian, gay and bisexual community: a

population-based study from the U.S. Pacific Northwest. *Prev Med* 2009;48(6):555-61.

17. Easton A, Jackson K, Mowery P, Comeau D, Sell R. Adolescent same-sex and both-sex romantic attractions and relationships: implications for smoking. *Am J Public Health* 2008;98(3):462-7.

18. Corliss H, Wadler B, Jun H-J, Rosario M, Wypij D, Frazier L, et al. Sexual-orientation disparities in cigarette smoking in a longitudinal cohort study of adolescents. *Nicotine & Tobacco Research* in press.

19. McKirnan DJ, Tolou-Shams M, Turner L, Dyslin K, Hope B. Elevated risk for tobacco use among men who have sex with men is mediated by demographic and psychosocial variables. *Subst Use Misuse* 2006;41(8):1197-208.

20. Ortiz-Hernandez L, Tello BL, Valdes J. The association of sexual orientation with self-rated health, and cigarette and alcohol use in Mexican adolescents and youths. *Soc Sci Med* 2009;69(1):85-93.

21. King M, Nazareth I. The health of people classified as lesbian, gay and bisexual attending family practitioners in London: a controlled study. *BMC Public Health* 2006;6:127.

22. Mercer CH, Bailey JV, Johnson AM, Erens B, Wellings K, Fenton KA, et al. Women who report having sex with women: British national probability data on prevalence, sexual behaviors, and health outcomes. *Am J Public Health* 2007;97(6):1126-33.

23. Trocki KF, Drabble LA, Midanik LT. Tobacco, marijuana, and sensation seeking: comparisons across gay, lesbian, bisexual, and heterosexual groups. *Psychol Addict Behav* 2009;23(4):620-31.

24. Lindley LL, Walsemann KM, Carter JW, Jr. The association of sexual orientation measures with young adults' health-related outcomes. *Am J Public Health* 2012;102(6):1177-85.

25. Needham BL. Sexual attraction and trajectories of mental health and substance use during the transition from adolescence to adulthood. *J Youth Adolesc* 2012;41(2):179-90.

26. Case P, Austin SB, Hunter DJ, Manson JE, Malspeis S, Willett WC, et al. Sexual orientation, health risk factors, and physical functioning in the Nurses' Health Study II. *Journal of Womens Health* 2004;13(9):1033-47.

27. Corliss HL, Rosario M, Wypij D, Fisher LB, Austin SB. Sexual Orientation Disparities in Longitudinal Alcohol Use Patterns Among Adolescents Findings From the Growing Up Today Study. *Archives of Pediatrics & Adolescent Medicine* 2008;162(11):1071-78.

28. Chakraborty A, McManus S, Brugha TS, Bebbington P, King M. Mental health of the non-heterosexual population of England. *British Journal of Psychiatry* 2011;198(2):143-48.

29. King M, McKeown E, Warner J, Ramsay A, Johnson K, Cort C, et al. Mental health and quality of life of gay men and lesbians in England and Wales - Controlled, cross-sectional study. *British Journal of Psychiatry* 2003;183:552-58.

30. Talley AE, Sher KJ, Littlefield AK. Sexual orientation and substance use trajectories in emerging adulthood. *Addiction* 2010;105(7):1235-45.

31. Boehmer U, Miao X, Linkletter C, Clark MA. Adult Health Behaviors Over the Life Course by Sexual Orientation. *American Journal of Public Health* 2012;102(2):292-300.

32. Keogh P, Reid D, Bourne A, Weatherburn P, Hickson F, Jessup K, et al. Wasted opportunities: Problematic alcohol and drug use among gay men and bisexual men. London: Sigma Research, 2009.

33. Sigma research. *Consuming passions: findings from the United Kingdom Gay Men's Sex Survey 2005*. London: Sigma Research, 2008.

- 1
2
3 34. Dilley JA, Maher JE, Boysun MJ, Pizacani BA, Mosbaek CH, Rohde K, et al. Response
4 letter to: Tang H, Greenwood GL, Cowling DW, Lloyd JC, Roeseler AG, Bal DG.
5 Cigarette smoking among lesbians, gays, and bisexuals: how serious a problem?
6 *Cancer Causes Control* 2005;16(9):1133-4.
7
8 35. Blosnich J, Lee JG, Horn K. A systematic review of the aetiology of tobacco disparities
9 for sexual minorities. *Tob Control* 2011.
10 36. Marshal MP, Friedman MS, Stall R, King KM, Miles J, Gold MA, et al. Sexual
11 orientation and adolescent substance use: a meta-analysis and methodological review.
12 *Addiction* 2008;103(4):546-56.
13 37. Ryan H, Wortley PM, Easton A, Pederson L, Greenwood G. Smoking among lesbians,
14 gays, and bisexuals: a review of the literature. *Am J Prev Med* 2001;21(2):142-9.
15 38. Gervais A, O'Loughlin J, Meshefedjian G, Bancej C, Tremblay M. Milestones in the
16 natural course of onset of cigarette use among adolescents. *Canadian Medical*
17 *Association Journal* 2006;175(3):255-61.
18 39. Talley AE, Aranda F, Hughes TL, Marshal MP, Sher KJ. Does differential endorsement
19 of dimensions of sexual orientation relate to problematic drinking and depressive
20 symptoms? *Alcoholism-Clinical and Experimental Research* 2012;36:218A-18A.
21 40. Smith EA, Malone RE. The outing of Philip Morris: advertising tobacco to gay men. *Am*
22 *J Public Health* 2003;93(6):988-93.
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Table 1. Descriptive statistics for study variables (unweighted), according to sexual orientation identity in 2009, N(%) or mean(SD)

N=6656 ^a	Lesbian or gay (N = 88, 1.3)	Bisexual (N = 142, 2.1)	Heterosexual (N = 6426, 96.5)	p ^c	p ^d
Female	33 (37.5)	108 (76.1)	3197 (49.8)	0.02	0.19
Ethnic minority ^b	12 (13.6)	11 (7.7)	1169 (18.2)	0.27	0.01
Parental education (degree level)	35 (39.8)	53 (37.3)	2411 (37.5)	0.67	0.73
Parental occupation (professional)	25 (28.4)	37 (26.1)	1574 (24.5)	0.39	0.35
History of cigarette smoking	35 (39.8)	60 (42.3)	1596 (24.8)	0.002	<0.001
Weekly alcohol drinker (2009, age 18/19)	67 (76.1)	97 (68.3)	4263 (66.3)	0.06	0.06
% of alcohol drinkers with hazardous drinking pattern (2009, age 18/19)	49 (73.1)	80 (56.3)	3300 (51.4)	0.02	0.04

^aAnalytic sample (N = 6656) comprises participants with available data on age, sex, ethnic group, parental education and occupational social class, smoking (2004) and alcohol use (2004 and 2009).

^bUnweighted frequency.

^cp value for gay/lesbian vs. heterosexual (chi-square test).

^dp value for linear trend across gay/lesbian, bisexual and heterosexual.

Table 2. Association between sexual orientation identity and smoking

	Cigarette smoker		Weekly alcohol drinker		Hazardous alcohol drinking pattern (among male weekly drinkers)		Hazardous alcohol drinking pattern (among female weekly drinkers)	
	N = 6656 ^a		N = 6656 ^a		N = 2371		N = 2056	
	Minimally adjusted ^b	Fully adjusted ^c	Minimally adjusted ^b	Fully adjusted ^c	Minimally adjusted ^b	Fully adjusted ^c	Minimally adjusted ^b	Fully adjusted ^c
Lesbian or gay (vs. heterosexual)	1.57 (1.18,2.08)	1.57 (1.18,2.09)	1.12 (0.81,1.57)	1.10 (0.79,1.53)	2.00 (1.27,3.15)	2.01 (1.28,3.15)	0.92 (0.55,1.55)	0.92 (0.54,1.55)
Bisexual (vs. heterosexual)	1.49 (1.20,1.84)	1.50 (1.21,1.86)	1.00 (0.79,1.26)	0.97 (0.76,1.22)	2.00 (1.17,3.44)	0.90 (0.53,1.56)	0.92 (0.67,1.25)	0.92 (0.68,1.26)
Lesbian, gay or bisexual (vs. heterosexual)	1.52 (1.27,1.81)	1.52 (1.28,1.82)	1.04 (0.86,1.27)	1.01 (0.83,1.23)	1.09 (0.87,1.35)	1.09 (0.88,1.35)	0.93 (0.70,1.23)	0.92 (0.70,1.22)

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^aAnalytic sample (comprises participants with available data on age, sex, ethnic group, parental education and occupational social class, smoking and alcohol use. Sample weights are applied.

^bAdjusted for age and sex

^cAdjusted for age, sex, parental educational attainment, parental occupational social class, ethnic minority status.

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STROBE Statement—Checklist of items that should be included in reports of *cohort studies*

	Item No	Page No	Recommendation
Title and abstract	1	1	(a) Indicate the study’s design with a commonly used term in the title or the abstract
		2	(b) Provide in the abstract an informative and balanced summary of what was done and what was found
Introduction			
Background/rationale	2	6	Explain the scientific background and rationale for the investigation being reported
Objectives	3	7	State specific objectives, including any prespecified hypotheses
Methods			
Study design	4	7	Present key elements of study design early in the paper
Setting	5	7	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
Participants	6	7	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up
			(b) For matched studies, give matching criteria and number of exposed and unexposed
Variables	7	7-9	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
Data sources/ measurement	8*	7	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group
Bias	9	9-10	Describe any efforts to address potential sources of bias
Study size	10	10	Explain how the study size was arrived at
Quantitative variables	11	7-9	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods	12	9-10	(a) Describe all statistical methods, including those used to control for confounding
		9-10	(b) Describe any methods used to examine subgroups and interactions
		10	(c) Explain how missing data were addressed
		N/A	(d) If applicable, explain how loss to follow-up was addressed
		9	(e) Describe any sensitivity analyses
Results			
Participants	13*	7,10	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed
		N/A	(b) Give reasons for non-participation at each stage
		N/A	(c) Consider use of a flow diagram
Descriptive data	14*	10	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders
		10	(b) Indicate number of participants with missing data for each variable of interest
		N/A	(c) Summarise follow-up time (eg, average and total amount)
Outcome data	15*	19	Report numbers of outcome events or summary measures over time
Main results	16	10	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear

			which confounders were adjusted for and why they were included
		7-9	(b) Report category boundaries when continuous variables were categorized
		N/A	(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17	10,12	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses
Discussion			
Key results	18	12	Summarise key results with reference to study objectives
Limitations	19		Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
Interpretation	20	12-15	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
Generalisability	21	15	Discuss the generalisability (external validity) of the study results
Other information			
Funding	22	N/A	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at <http://www.strobe-statement.org>.



**Sexual orientation identity in relation to smoking history
and alcohol use at age 18/19: Cross-sectional associations
from wave 6 of the Longitudinal Study of Young People in
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Sexual orientation identity in relation to smoking history and alcohol use at age 18/19: Cross-sectional associations from wave 6 of the Longitudinal Study of Young People in England (LSYPE)

Running head: Sexual orientation, smoking, alcohol use.

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Abstract

Objectives. Information about the health behaviours of minority groups is essential for addressing health inequalities. We evaluated the association between lesbian, gay or bisexual (LGB) sexual orientation identity and smoking and alcohol use in young people in England.

Design. Data drawn from wave 6 of the Longitudinal Study of Young People in England (LSYPE).

Setting. Self-completion questionnaires during home visits, face-to-face interviews, and web-based questionnaires.

Participants. Data from 7698 participants (3762 men) with information on sexual orientation identity and health behaviours at age 18/19.

Outcome measures. Cigarette smoking history, alcohol drinking frequency, and risky single occasion drinking (RSOD).

Results. LGB identity was reported by 3.1% of participants (55 gay, 33 lesbian, 35 bisexual male, 111 bisexual female), 3.5% when adjusting for the survey design. Adjusting for a range of covariates, identification as lesbian/gay was found to be associated with smoking (OR = 2.28, 95% CI 1.46, 3.58), alcohol drinking >2 days/week (OR = 1.96, 95% CI 1.24, 3.11), and RSOD (OR = 1.76, 95% CI 1.11, 2.79) more than weekly. Bisexual identity was associated with smoking history (OR = 1.87, 95% CI 1.32, 2.64) and RSOD (OR = 1.02, 95% CI 1.02, 2.79), but not alcohol drinking >2 days/week (OR = 1.17, 95% CI 0.78, 1.77).

Conclusions. In a sample of over 7600 young people age 18/19 in England, lesbian/gay identity is associated smoking, drinking alcohol frequency and RSOD. Bisexual identity is associated with smoking and RSOD, but not alcohol drinking frequency.

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Key words: Alcohol Drinking, Alcoholic Intoxication, Cigarette Smoking, Cohort Studies,
Sexuality.

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Article summary

Article focus

- Studies, mainly from the US, have found an association between lesbian, gay or bisexual (LGB) sexual orientation and cigarette smoking
- Previous results for alcohol use are mixed, therefore the association should be tested

Key messages

- LGB orientation identity is associated with higher rates of smoking history in a population sample of English 18/19 year-olds
- Lesbian or gay orientation is associated with drinking alcohol more than twice per week and risky single occasion drinking
- Bisexual orientation is associated with risky single occasion drinking but not alcohol drinking frequency
- Recording sexual orientation is necessary for describing health inequalities and among young people, there is a very low refusal rate (0.1%)

Strengths and limitations of this study

- This cohort is among the first in the UK to record sexual orientation identity
- Smoking history but not current smoking status was recorded at age 18/19
- Frequency but not quantity of alcohol consumption was available

Introduction

Knowledge about the health behaviours of sexual minority groups is necessary for monitoring health inequalities, developing public health policies, allocating resources and targeting high risk groups for interventions ¹⁻³. It is estimated that between 1.5% ⁴ and 5% ⁵ of the UK population are lesbian, gay, or bisexual (LGB). Estimates tend to be larger when attraction or sexual behaviour are used to define sexual orientation ⁶⁻⁸. Additionally, estimates are found to vary by age and ethnic group ⁴. Relatively few research studies include a measure of sexual orientation identity, particularly in the UK. As a result, the evidence base on health inequalities for LGB groups is very sparse. Exceptions include the ONS Integrated Household Survey ⁴ and the Longitudinal Study of Young People in England ⁹ which both included the question for the first time in 2009, and the Scottish Household Survey from 2011.

Cigarette smoking is a prevalent behaviour among young people ¹⁰. Many studies have shown an association between LGB orientation and cigarette smoking ^{11-13 15 19 25 26 11}, particularly in the US ^{3 12-21} but also in different countries ²²⁻²⁴. The association is found in men and women and in different age groups, with some exceptions ^{23 25-28}, but particularly in young LGB people ^{11 29}. Occasionally the association is found to be stronger in women ^{23 25-27}. Some studies have used sexual orientation identity as a measure of sexual orientation ^{11 13 25 26}, some used same-sex attraction ^{18 27} and some used multiple measures ^{3 30}.

Alcohol use is also common among young people, but evidence supporting an association between LGB identity and alcohol use is mixed ^{3 26 31 32}, with evidence for possible effect modification by sex ^{3 26 32}. A systematic review found increased risk of alcohol dependence in men and women and an association between LB identity and alcohol misuse in women only ³. A pooled analysis of data from 14 countries found greater alcohol intake and more risky single occasion drinking in lesbian women but not gay men ³², compared to heterosexuals. Studies reporting an association between gay/bisexual male (hereafter, GB men) identity and heavier alcohol use are fewer, with one finding

an association specific to those under 50²⁰. There is evidence of a higher prevalence of heavy and potentially hazardous alcohol use among GB men recruited from recreational spaces, gay pride events and web surveys^{33 34}.

Several studies have found an association among lesbian/bisexual women (hereafter, LB women) compared to heterosexual women for greater alcohol intake^{27 28 35-37}, alcohol dependence^{37 38}, and risky single occasion drinking^{15 23 37 39-42}. One study found elevated risk of alcohol use among lesbian/bisexual females and 'mostly heterosexual' males, but not gay males⁴². Similar patterns have been found among adolescents in the transition to early adulthood^{29 42 43}, among University students⁴⁰, in midlife³⁵, across the adult age range^{23 38 39 41}, when using behavioural definitions of sexual orientation²⁴ and in different countries including Mexico²² and the UK^{23 24 27 39}.

The aim of our study was to estimate the association between LGB orientation identity and cigarette smoking history, frequency of drinking alcohol more than twice per week and risky single occasion drinking, in young people (age 18/19) in England.

Methods

The Longitudinal Study of Young People in England (LSYPE) is a prospective cohort study of English school pupils with repeated annual follow-ups⁹. At recruitment in 2004, participants (N = 15,770) were typically aged 13/14. The cohort was created to evaluate the transitions made by young people from secondary and tertiary education into adulthood. Pupils and parents were invited to participate by letter, using databases of schools to identify potential participants. Schools were defined as socio-economically deprived if they fell within the lowest quintile of schools ranked according to the proportion of pupils in receipt of school meals. Socio-economically deprived schools were over-sampled by a factor 1.5 and ethnic minority groups to N=1000 per group. Annual home interview visits incorporated a computer-assisted self-completion element, including questions about smoking (most recently in 2006, typical age 15/16), alcohol consumption and sexual orientation identity (both in 2009, age 18/19). In 2009, participants were offered either a

home visit (face-to-face interview and computer-assisted self-completion questionnaire), telephone interview or web questionnaire.

Sexual orientation identity. Sexual orientation identity was measured in 2009 using the question ‘Which of the following best describes how you think of yourself?’ for the web questionnaire (N = 2690, 40.4%), and for the home visit (N = 848, 12.7%) and telephone interview (N = 3118, 46.8%), ‘I will now read out a list of terms people sometimes use to describe how they think of themselves: Heterosexual or straight; Gay or lesbian; Bisexual, Other. As I read the list again please say ‘yes’ when you hear the option that best describes how you think of yourself’. These response options are recommended by the Office of National Statistics ⁴. The refusal rate for this question was 0.1% and 0.3% reported ‘Other’.

Cigarette smoking. Cigarette smoking was last measured in 2006 (typical age 15/16) with the question ‘Do you ever smoke cigarettes at all?’ followed by six response options (I have never smoked, I have only ever tried smoking once, I used to smoke sometimes but I never smoke a cigarette now, I sometimes smoke cigarettes now but I don't smoke as many as one a week, I usually smoke between one and six cigarettes a week, I usually smoke more than six cigarettes a week). These were grouped into smoker (sometimes or weekly smoking) versus non-smoker.

Weekly alcohol drinking. Alcohol drinking was measured in 2009 using the question ‘Thinking about the last 12 months, about how often did you usually have an alcoholic drink?’ with seven response options (Almost every day, Five or six days a week, Three or four days a week, Once or twice a week, Once or twice a month, Once every couple of months, Once or twice a year). Responses were grouped into ‘more than twice per week’ versus ‘less than twice per week’.

Risky single occasion drinking. Participants were asked, ‘On those days when you did have an alcoholic drink, how often would you say you got drunk?’ followed by six response options (Every time, Most times, Around half the time, Less than half the time, Rarely, Never). This information was combined with alcohol drinking frequency to identify participants who reported drunkenness

more than 52 times per year, equivalent to drinking alcohol to intoxication more than once per week.

Demographic covariates. Age and sex were recorded at baseline in 2004. Pupils self-reported their ethnic group and responses were grouped into five categories: White, Mixed, Indian/Pakistani/Bangladeshi, Black Caribbean/Black African, Chinese; grouped into 'ethnic minority' (1) or White (0). The maximum of either parent's educational attainment was recorded on a six-point scale ranging from 'no qualification' (0) to 'degree or equivalent' (6). Occupational social class was recorded on an eight-point scale ranging from 'never worked or long term unemployed' (1) to 'higher managerial and professional occupations' (8), for one or both parents. Parental education attainment and occupational class are both considered indicators of parental socio-economic status (SES).

Statistical analysis. For descriptive analyses, chi-square tests were used to identify significant differences for gay/bisexual vs. heterosexual participants for each study variable. Logistic regression was used to identify whether the mode of survey administration (home visit, telephone interview or web questionnaire) influenced reporting of LGB identity. For the main analysis, logistic regression was used to calculate odds ratios that summarized the relative risk of cigarette smoking, weekly alcohol drinking and hazardous alcohol drinking among weekly alcohol drinkers, according to sexual orientation identity (gay vs. heterosexual and bisexual vs. heterosexual). We minimally adjusted the odds ratios for age and sex, and then additionally adjusted the estimates for ethnic minority status, parental education and social class. Ethnicity and socio-economic status are possible confounding factors, because they may be associated both with sexual identity and with health behaviours. We also combined gay/lesbian and bisexual into a single 'LGB' category for additional analysis. Sample weights were used to obtain correct standard errors, allowing for over-sampling of schools with low socio-economic status and for ethnic minority pupils at recruitment. Although statistical power for evaluating possible effect modification by gender and socio-economic status was low, previous studies have shown sex differences (particularly for alcohol

use). We therefore ran separate models for males and females in supplementary analyses. In sensitivity analysis, we additionally controlled for mode of survey administration, to evaluate if this influenced the results. All analyses were performed with Stata version 12.1.

Results

The analytic sample comprised 7698 participants with data on sexual orientation identity, smoking history and alcohol use in addition to covariates (home visit = 12.2%, telephone interview = 47.6%, web questionnaire = 40.1%). Compared to the recruitment sample and adjusting for the study design, the analytic sample contained slightly fewer men (49.4% vs. 53.9%, $p < 0.001$), fewer ethnic minorities (9.9% vs. 14.9%, $p < 0.001$), fewer participants whose parents had less than secondary school level educational qualifications (17.0% vs. 29.2%, $p < 0.001$) and fewer participants with parents who were unemployed or had routine occupations (8.1% vs. 15.5%, $p < 0.001$).

Unweighted descriptive statistics for study variables are shown in Table 1. A total of 3% were classified as lesbian, gay or bisexual (55 gay men, 33 lesbian women, 34 bisexual men, 108 bisexual women, 3229 heterosexual men, 3197 heterosexual women). There were fewer women (37.5%) in the ‘LG’ category than men, but more women (76.0%) in the ‘B’ category than men. When using sample weights to correct for over-sampling of ethnic minority groups and schools with higher socio-economic deprivation however, the proportion of participants classified as LGB was 3.5% (1.3 LG, 2.2% B).

Compared to the web survey, participants completing the telephone interview were more likely to report heterosexual compared to LGB identity (OR = 1.55, 95% CI 1.16, 2.06). There were no significant differences in reporting heterosexual identity between the home visit and the web survey (OR = 1.16, 95% CI 0.77, 1.73), although this test may be under-powered (there were 33 LGB participants for face-to-face interviews, 86 for telephone interviews and 115 for web questionnaires).

Results from the logistic regression analyses are shown in Table 2, minimally adjusted for age and sex and then after further adjustments for ethnic minority status, parental educational attainment and occupational social class (parental SES). Sample weights were used in the models to correct for over-sampling of ethnic minority groups and socio-economically deprived schools at recruitment.

Lesbian or gay participants were more than twice as likely to have a history of cigarette smoking, and bisexual participants nearly twice as likely to have smoked. Adjustment for ethnic minority status and parental SES did not change these results materially. Similar results were found when combining participants into LGB vs. heterosexual.

Participants who identified themselves as lesbian or gay were nearly twice as likely to drink alcohol more than twice a week, even after adjustment for several covariates. There was no association between bisexual identity and drinking alcohol more than twice a week. When combining LGB participants together, the association was weaker but remained significant, in both minimally and fully adjusted models.

Lesbian or gay participants were around 1.8 times more likely to report risky single occasion drinking more than weekly. This association was only slightly weaker in the fully adjusted model. There was no association between bisexual identity and greater than weekly risky single occasion drinking. The combined LGB category was associated with this measure only in the fully adjusted model.

In supplementary analyses separating males and females, the pattern of results for smoking history was very similar for both genders (Table S1), although it was weaker for bisexual males. For alcohol drinking greater than twice per week however, the association was stronger in males than in females. The size of the association was similar for gay men and lesbian women, although confidence intervals were wider for lesbian women. No association was apparent for bisexual men, although there was a non-significant trend toward increased risk for bisexual women. For risky single occasion drinking, the association was stronger and significant in males but a weaker non-

significant trend was suggested for females. Bisexual males appeared to be at decreased risk of risky single occasion drinking but this was not significant. These supplementary results should be interpreted with caution, given the small numbers of participants involved. The study may be underpowered to examine effect modification of the association between sexual orientation and health behaviours.

Discussion

In a community-dwelling sample of over 7600 young adults in England, men and women reporting a gay/lesbian or bisexual (LGB) identity were around twice as likely to have a history of cigarette smoking at age 15/16 than those reporting a heterosexual identity at age 18/19. Lesbian or gay participants were nearly twice as likely to report drinking alcohol more than twice per week, and more likely to report risky single occasion drinking more often than weekly. Bisexual participants were no more likely to report risky single occasion drinking than heterosexuals.

Strengths of the study include the large sample which was representative of an entire school year in England at recruitment, typically from the birth years 1990/91. Data from the UK on sexual orientation identity are exceptionally rare, particularly for young cohorts^{24 38}. Adjusting for the sample design, 3.5% of this cohort identified as LGB at age 18/19. The refusal rate for the sexual orientation identity question was low, particularly in the web survey, and differences in how this question was administered were not found to influence results materially. Several major cohort studies in the US^{41 44} have included questions on sexual orientation identity in recent years. In the UK however, data on health inequalities in LGB identified adults has historically come from cross-sectional surveys recruited using snowball sampling³⁹, gay pride events and internet surveys³⁴ which do not address issues of representativeness fully, even when a heterosexual control group is available³⁹. Recruitment from recreational spaces, particularly before the smoking ban, may have introduced bias into earlier studies. The long-demonstrated association between LGB orientation and smoking^{3 43 45 46} appears to have persisted even in this young cohort.

A clear limitation of our study was that smoking status was last assessed in 2006 (age 15/16), two years before sexual orientation was last recorded. Participants may have changed their sexual orientation identity⁴⁰ or smoking status between 2006 and 2009, and so the data cannot establish an association with current smoking. Smoking is not known to influence sexual orientation identity, making reverse causation an unlikely explanation. It is worth noting however, that young people who begin smoking tend to continue into adulthood⁴⁷ and two-thirds of smokers begin before age 18¹⁰, suggesting that many of those reporting a history of smoking are still current smokers. A second limitation is that statistical power may not have been available to detect smaller associations, owing to the relatively small proportion of participants in sexual minority groups, particularly for supplementary analyses of men and women separately. A third limitation was that aspects of sexual orientation other than identity such as attraction and behaviours^{8 26 48} were not recorded. Finally, the percentage of participants identifying as LGB may have been underestimated, particularly if this had not been disclosed to parents, who might have been in the home during telephone and home interviews. Although the refusal rate for the question was low, some participants who identify as LGB might have responded 'heterosexual' for this and other reasons, which might include socially desirable responding.^{4 49} This would lead to misclassification bias, leading us to have under-estimated the size of any associations found. Results were similar when additionally controlling for mode of survey administration (home visit, telephone, web survey), mitigating concerns that the results are driven by the method of data collection.

Although our finding that LGB orientation is associated with smoking history is largely consistent with other studies, the results concerning drinking alcohol to intoxication differ from prior reports. In several US studies, the association between LGB identity and hazardous alcohol use tends to be stronger among LB women^{15 23 39-41} and in a systematic review, LB identity in women was associated with alcohol dependence and misuse; misuse defined as >21/14 units/week in men/women³. It is important to emphasize however that our study measured alcohol drinking

frequency and frequency of drinking to intoxication, not dependence or misuse. Studies from the US involving younger cohorts have reported associations with hazardous alcohol drinking⁴³ for LGB men^{30 50} and women^{36 40}. Overall, the picture is mixed. Some studies find are stronger association between LG or GB identity and alcohol use in women^{42 51}, some find a stronger association in men³¹, and some an association for B but not L women⁵¹. Our results show an association between LG identity in men and women combined, similar patterns when separating men and women, but with a stronger association in men (Table S1). L or G identity among English youth, but not B identity, is associated with more frequent and riskier single occasion drinking. Environmental differences between the UK and US could influence the behaviours of adults who identify as LGB. Such influences might include the age of consent, legal drinking age, laws concerning discrimination, availability of social support and recreational spaces for socializing. A study of students with same-sex sexual experiences found that greater LGB resources were associated with less smoking in women but increased risk of binge drinking in men⁵². Future international comparisons are necessary, and a pooled meta-analysis of individual participant data (MIPD) would be very valuable.

It is important to identify the underlying mechanisms that connect LGB identity to health behaviours. There is apparently no evidence for genetic covariance between sexual orientation identity and health behaviours, and we suggest that sexual orientation itself is unlikely to cause smoking and alcohol use. Several possible mechanisms have been proposed, which require further investigation. The concept of ‘minority stress’³⁸ is often invoked to explain how heterosexism and homophobia are internalised, perhaps leading people to self-medicate psychological distress with cigarettes or alcohol³⁶. A recent review found support for this theory, particularly in explaining associations with victimisation and substance use⁵³. Alternatively, LGB young people may socialize or have socialized in recreational spaces where cigarettes and alcohol are easily available, where peer norms encourage engagement in these behaviours⁴⁰, or to appear older than their actual age. Concern with appearance could motivate smoking as a weight management strategy. For some,

1 smoking can be sexually arousing, particularly if it is associated with masculinity⁵⁴ or where there is
2 a sexual attraction to men smoking⁵⁵. Other commentators have noted the role of the tobacco
3 industry in targeting LGB smokers⁵⁴. Early unhealthy behaviours among LGB young people may
4 influence trajectories toward chronic disease in later life^{15 27}. Longitudinal repeated measures data
5 will be necessary in order to identify the antecedents and consequences of unhealthy behaviours for
6 LGB young people in the UK, across the life course. In our view, there is a clear need for a repeated
7 measures cohort study of LGB people.

8
9 Despite recent equality and diversity legislation and the inclusion of sexual orientation in the
10 National Health Service (NHS) Equality Delivery System, sexual orientation identity is rarely
11 monitored by NHS organisations or measured in epidemiological studies. To improve the evidence
12 base, and support international comparisons, data about sexual orientation should be collected
13 routinely¹⁻³. In the Integrated Household Survey for example, it will now be possible to consider
14 sexual orientation identity in relation to health status, smoking and subjective wellbeing, among
15 other topics. Questions about sexual orientation can be added at low cost and have relatively low
16 refusal rates, particularly among young people. Wider measurement of sexual orientation would
17 ultimately help reduce health inequalities.

18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60

Author contributions

Isla Fitchie conducted the literature review. Gareth Hagger-Johnson did the analyses. All authors contributed to writing the manuscript.

Data sharing statement

Data are available from the UK Data Archive.

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References

1. McCabe SE, Hughes TL, Bostwick W, *et al.* Measurement of sexual identity in surveys: implications for substance abuse research. *Arch Sex Behav* 2012;**41**:649-57.

2. Dilley JA, Simmons KW, Boysun MJ, *et al.* Demonstrating the importance and feasibility of including sexual orientation in public health surveys: health disparities in the Pacific Northwest. *Am J Public Health* 2010;**100**:460-67.

3. Lee JGL, Griffin GK, Melvin CL. Tobacco use among sexual minorities in the USA, 1987 to May 2007: a systematic review. *Tob Control* 2009;**18**:275-82.

4. Office for National Statistics. *Measuring Sexual Identity: An Evaluation Report*. 2010. <http://www.ons.gov.uk/ons/rel/ethnicity/measuring-sexual-identity---evaluation-report/2010/index.html> (accessed 28 April 2013).

5. Johnson AM, Mercer CH, Erens B, *et al.* Sexual behaviour in Britain: partnerships, practices, and HIV risk behaviours. *Lancet* 2001;**358**:1835-42.

6. Bostwick WB, Boyd CJ, Hughes TL, *et al.* Dimensions of sexual orientation and the prevalence of mood and anxiety disorders in the United States. *Am J Public Health* 2010;**100**:468-75.

7. Corte C, Matthews A, Kuhn L, *et al.* Dimensions of sexual identity development and alcohol and drug-related risk behavior in sexual minority men. *Alcohol Clin Exp Res* 2010;**34**:241A-41A.

8. McCabe SE, Hughes TL, Bostwick W, *et al.* Assessment of difference in dimensions of sexual orientation: Implications for substance use research in a college-age population. *J Stud Alcohol* 2005;**66**:620-29.

9. Department for Education and National Centre for Social Research, *Longitudinal Study of Young People in England: Waves One to Seven, 2004-2010* [computer file]. 12th Edition. Colchester, Essex: UK Data Archive [distributor], August 2012. SN: 5545 <http://dx.doi.org/10.5255/UKDA-SN-5545-3> (accessed 14/01/2013)

10. The Health and Social Care Information Centre. *Statistics on Smoking: England, 2010*.
<http://www.hscic.gov.uk/pubs/smoking10> (accessed 28 April 2013)
11. Austin SB, Ziyadeh N, Fisher LB, *et al*. Sexual orientation and tobacco use in a cohort study of US adolescent girls and boys. *Arch Pediatr Adolesc Med* 2004;**158**:317-22.
12. Tang H, Greenwood GL, Cowling DW, *et al*. Cigarette smoking among lesbians, gays, and bisexuals: how serious a problem? *Cancer Causes Control* 2004;**15**:797-803.
13. Gruskin EP, Gordon N. Gay/Lesbian sexual orientation increases risk for cigarette smoking and heavy drinking among members of a large Northern California health plan. *BMC Public Health* 2006;**6**:241.
14. Gruskin EP, Greenwood GL, Matevia M, *et al*. Disparities in smoking between the lesbian, gay, and bisexual population and the general population in California. *Am J Public Health* 2007;**97**:1496-502.
15. Marshal MP, Friedman MS, Stall R, *et al*. Individual trajectories of substance use in lesbian, gay and bisexual youth and heterosexual youth. *Addiction* 2009;**104**:974-81.
16. Hatzenbuehler ML, Wieringa NF, Keyes KM. Community-level determinants of tobacco use disparities in lesbian, gay, and bisexual youth: results from a population-based study. *Arch Pediatr Adolesc Med* 2011;**165**:527-32.
17. Pizacani BA, Rohde K, Bushore C, *et al*. Smoking-related knowledge, attitudes and behaviors in the lesbian, gay and bisexual community: a population-based study from the U.S. Pacific Northwest. *Prev Med* 2009;**48**:555-61.
18. Easton A, Jackson K, Mowery P, *et al*. Adolescent same-sex and both-sex romantic attractions and relationships: implications for smoking. *Am J Public Health* 2008;**98**(3):462-7.
19. Corliss H, Wadler B, Jun H-J, *et al*. Sexual-orientation disparities in cigarette smoking in a longitudinal cohort study of adolescents. *Nicotine Tob Res* 2013;**15**:213-22.

20. McKirnan DJ, Tolou-Shams M, Turner L, *et al.* Elevated risk for tobacco use among men who have sex with men is mediated by demographic and psychosocial variables. *Subst Use Misuse* 2006;**41**:1197-208.

21. Austin EL, Irwin JA. Age differences in the correlates of problematic alcohol use among southern lesbians. *J Stud Alcohol Drugs* 2010;**71**:295-8.

22. Ortiz-Hernandez L, Tello BL, Valdes J. The association of sexual orientation with self-rated health, and cigarette and alcohol use in Mexican adolescents and youths. *Soc Sci Med* 2009;**69**:85-93.

23. King M, Nazareth I. The health of people classified as lesbian, gay and bisexual attending family practitioners in London: a controlled study. *BMC Public Health* 2006;**6**:127.

24. Mercer CH, Bailey JV, Johnson AM, *et al.* Women who report having sex with women: British national probability data on prevalence, sexual behaviors, and health outcomes. *Am J Public Health* 2007;**97**:1126-33.

25. Trocki KF, Drabble LA, Midanik LT. Tobacco, marijuana, and sensation seeking: comparisons across gay, lesbian, bisexual, and heterosexual groups. *Psychol Addict Behav* 2009;**23**:620-31.

26. Lindley LL, Walsemann KM, Carter JW, Jr. The association of sexual orientation measures with young adults' health-related outcomes. *Am J Public Health* 2012;**102**:1177-85.

27. Needham BL. Sexual attraction and trajectories of mental health and substance use during the transition from adolescence to adulthood. *J Youth Adolesc* 2012;**41**:179-90.

28. Needham BL, Austin EL. Sexual orientation, parental support, and health during the transition to young adulthood. *J Youth Adolesc* 2010;**39**:1189-98.

29. Tucker JS, Ellickson PL, Klein DJ. Understanding differences in substance use among bisexual and heterosexual young women. *Womens Health Issues* 2008;**18**:387-98.

30. Brewster KL, Tillman KH. Sexual Orientation and Substance Use Among Adolescents and Young Adults. *Am J Public Health* 2012;**102**:1168-76.

31. Caldwell LL, Kivel BD, Smith EA, *et al.* The leisure context of adolescents who are lesbian, gay male, bisexual and questioning their sexual identities: An exploratory study. *J Leis Res* 1998;**30**:341-55.
32. Bloomfield K, Wicki M, Wilsnack S, *et al.* International Differences in Alcohol Use According to Sexual Orientation. *Subst Abus* 2011;**32**:210-19.
33. Keogh P, Reid D, Bourne A, *et al.* *Wasted opportunities: Problematic alcohol and drug use among gay men and bisexual men.* London: Sigma Research, 2009.
34. Hickson, F. *Consuming passions: Findings from the United Kingdom gay men's sex survey 2005.* Sigma Research, 2007.
35. Case P, Austin SB, Hunter DJ, *et al.* Sexual orientation, health risk factors, and physical functioning in the Nurses' Health Study II. *J Womens Health* 2004;**13**:1033-47.
36. Corliss HL, Rosario M, Wypij D, *et al.* Sexual orientation disparities in longitudinal alcohol use patterns among adolescents findings from the Growing Up Today Study. *Arch Pediatr Adolesc Med* 2008;**162**:1071-78.
37. King M, Semlyen J, Tai S, *et al.* A systematic review of mental disorder, suicide, and deliberate self harm in lesbian, gay and bisexual people. *BMC Psychiatry* 2008;**8**:70.
38. Chakraborty A, McManus S, Brugha TS, *et al.* Mental health of the non-heterosexual population of England. *Br J Psychiatry* 2011;**198**:143-48.
39. King M, McKeown E, Warner J, *et al.* Mental health and quality of life of gay men and lesbians in England and Wales - Controlled, cross-sectional study. *Br J Psychiatry* 2003;**183**:552-58.
40. Talley AE, Sher KJ, Littlefield AK. Sexual orientation and substance use trajectories in emerging adulthood. *Addiction* 2010;**105**:1235-45.
41. Boehmer U, Miao X, Linkletter C, *et al.* Adult health behaviors over the life course by sexual orientation. *Am J Public Health* 2012;**102**:292-300.
42. Ziyadeh NJ, Prokop LA, Fisher LB, *et al.* Sexual orientation, gender, and alcohol use in a cohort study of US adolescent girls and boys. *Drug Alcohol Depend* 2007;**87**:119-30.

43. Marshal MP, Friedman MS, Stall R, *et al.* Sexual orientation and adolescent substance use: a meta-analysis and methodological review. *Addiction* 2008;**103**:546-56.

44. Corliss H, Wadler B, Jun H-J, *et al.* Sexual-orientation disparities in cigarette smoking in a longitudinal cohort study of adolescents. *Nicotine Tob Res* 2013;**15**:213-22.

45. Blosnich J, Lee JG, Horn K. A systematic review of the aetiology of tobacco disparities for sexual minorities. *Tob Control* 2013;**22**:66-73.

46. Ryan H, Wortley PM, Easton A, *et al.* Smoking among lesbians, gays, and bisexuals: a review of the literature. *Am J Prev Med* 2001;**21**:142-9.

47. Gervais A, O'Loughlin J, Meshefedjian G, *et al.* Milestones in the natural course of onset of cigarette use among adolescents. *CMAJ* 2006;**175**:255-61.

48. Talley AE, Sher KJ, Steinley D, *et al.* Patterns of alcohol use and consequences among empirically derived sexual minority subgroups. *J Stud Alcohol Drugs* 2012;**73**:290-302.

49. Mitchell K, Wellings K, Elam G, *et al.* How can we facilitate reliable reporting in surveys of sexual behaviour? Evidence from qualitative research. *Cult Health Sex* 2007;**9**:519-31.

50. Hatzenbuehler ML, Corbin WR, Fromme K. Trajectories and determinants of alcohol use among LGB young adults and their heterosexual peers: Results from a prospective study. *Dev Psychol* 2008;**44**:81-90.

51. Udry JR, Chantala K. Risk assessment of adolescents with same-sex relationships. *J Adolesc Health* 2002;**31**:84-92.

52. Eisenberg ME, Wechsler H. Social influences on substance-use behaviors of gay, lesbian, and bisexual college students: findings from a national study. *Soc Sci Med* 2003;**57**:1913-23.

53. Collier KL, van Beusekom G, Bos HMW, *et al.* Sexual Orientation and Gender Identity/Expression Related Peer Victimization in Adolescence: A Systematic Review of Associated Psychosocial and Health Outcomes. *J Sex Res* 2013;**50**:299-317.

54. Smith EA, Malone RE. The outing of Philip Morris: advertising tobacco to gay men. *Am J Public Health* 2003;**93**:988-93.

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2 55. Aronsson H, Lind J, Ghirlanda S, *et al.* Parental influences on sexual preferences: The case of
3
4 attraction to smoking. *Journal of Evolutionary Psychology* 2011;**9**:21-41.
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Table 1. Descriptive statistics for study variables (unweighted), according to sexual orientation identity in 2009, N(%)

Study variables (N = 7698) ^a	Lesbian or gay (n = 88, 1.1%)	Bisexual (n = 146, 1.9%)	Heterosexual (n = 7464, 97.0%)	p ^c	p ^d	p ^e
Female	33 (37.5)	111 (76.0)	3792 (50.8)	0.001	0.014	<0.001
Ethnic minority ^f	12 (13.6)	12 (8.2)	2112 (28.3)	<0.001	0.003	<0.001
Parental education (less than secondary)	13 (14.8)	26 (17.8)	1715 (23.0)	0.02	0.07	0.14
Parental occupation (routine or unemployed)	10 (11.4)	18 (12.3)	900 (12.1)	0.97	0.84	0.92
History of cigarette smoking (age 15/16)	35 (39.8)	60 (41.1)	1649 (22.1)	<0.001	<0.001	<0.001
Alcohol drinking >2 days/week (age 18/19)	33 (37.5)	38 (26.0)	1467 (19.7)	<0.001	<0.001	0.057
Risky single occasion drinking (age 18/19)	40 (45.5)	48 (32.9)	1985 (26.6)	<0.001	<0.001	0.090

^aAnalytic sample (N = 7698) comprises participants with available data on age, sex, ethnic group, parental education, occupational social class, smoking history and alcohol use. ^cp value for lesbian/gay/bisexual vs. heterosexual, ^dp value for gay/lesbian vs. heterosexual, ^ep bisexual vs. heterosexual. ^fUnweighted frequency (ethnic minority groups were over-sampled).

Table 2. Association between sexual orientation identity and smoking, alcohol drinking >2 days/week and risky single occasion drinking

N=7698	History of cigarette smoking		Alcohol drinking >2 days/week		>Weekly risky single occasion drinking	
	vs. non-smoker		vs. ≤2 days/week or never		vs. ≤weekly	
	Minimally	Fully	Minimally	Fully	Minimally	Fully
	adjusted ^b	adjusted ^c	adjusted ^b	adjusted ^c	adjusted ^b	adjusted ^c
<i>Model 1</i>						
Lesbian or gay	2.34***	2.23**	1.99***	1.99**	1.82***	1.80*
(vs. heterosexual)	(1.50, 3.65)	(1.42, 3.51)	(1.28, 3.09)	(1.25, 3.17)	(1.16, 2.84)	(1.13, 2.86)
Bisexual	1.94***	1.84**	1.26	1.20	1.11	1.04
(vs. heterosexual)	(1.37, 2.75)	(1.30, 2.61)	(0.84, 1.89)	(0.79, 1.81)	(0.76, 1.61)	(0.71, 2.86)
<i>Model 2</i>						
Lesbian, gay or bisexual	2.08***	1.98***	1.53***	1.48*	1.35*	1.29
(vs. heterosexual)	(1.57, 2.76)	(1.49, 2.63)	(1.15, 2.03)	(1.10, 1.99)	(1.01, 1.79)	(0.96, 1.74)

Values shown are odds ratios (95% confidence intervals). *** = $p < 0.001$, ** = $p < 0.01$, * = $p < 0.05$. ^aAnalytic sample (comprises participants with available data on age, sex, ethnic group, parental education and occupational social class, smoking and alcohol use. Sample weights are applied.

^bAdjusted for age and sex. ^cAdjusted for age, sex, ethnic minority status, parental educational attainment, parental occupational social class.

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Table S1. Association between sexual orientation identity and smoking, alcohol drinking >2 days/week and risky single occasion drinking

	History of cigarette smoking		Alcohol drinking >2 days/week		>Weekly risky single occasion drinking	
	vs. non-smoker		vs. ≤2 days/week or never		vs. ≤weekly	
	Minimally	Fully	Minimally	Fully	Minimally	Fully
	adjusted ^b	adjusted ^c	adjusted ^b	adjusted ^c	adjusted ^b	adjusted ^c
<i>Males (n = 3762)</i>						
Gay	2.38**	2.31**	1.92*	1.95*	2.13*	2.15*
(vs. heterosexual)	(1.31, 4.33)	(1.27, 4.20)	(1.10, 3.35)	(1.07, 3.55)	(1.21, 3.77)	(1.19, 3.87)
Bisexual	1.93	1.88	1.04	0.95	0.67	0.61
(vs. heterosexual)	(0.92, 4.09)	(0.88, 4.00)	(0.49, 2.20)	(0.44, 2.07)	(0.30, 1.46)	(0.27, 1.36)
<i>Females (n = 3936)</i>						
Gay	2.30*	2.14*	2.10	2.06	1.40	1.34
(vs. heterosexual)	(1.14, 4.62)	(1.04, 4.38)	(1.00, 4.42)	(0.84, 2.15)	(0.68, 2.88)	(0.63, 2.86)
Bisexual	1.93**	1.82*	1.39	1.35	1.32	1.26

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(vs. heterosexual)	(1.30, 2.87)	(1.23, 2.69)	(0.87, 2.21)	(0.84, 2.15)	(0.87, 2.00)	(0.82, 1.94)
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Values shown are odds ratios (95% confidence intervals). *** = $p < 0.001$, ** = $p < 0.01$, * = $p < 0.05$. ^aAnalytic sample (comprises participants with available data on age, sex, ethnic group, parental education and occupational social class, smoking and alcohol use. Sample weights are applied.

^bAdjusted for age. ^cAdjusted for age, ethnic minority status, parental educational attainment, parental occupational social class.

STROBE Statement—Checklist of items that should be included in reports of *cohort studies*

	Item No	Page No	Recommendation
Title and abstract	1	1	(a) Indicate the study’s design with a commonly used term in the title or the abstract
		2	(b) Provide in the abstract an informative and balanced summary of what was done and what was found
Introduction			
Background/rationale	2	5	Explain the scientific background and rationale for the investigation being reported
Objectives	3	6	State specific objectives, including any prespecified hypotheses
Methods			
Study design	4	6	Present key elements of study design early in the paper
Setting	5		Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
Participants	6	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up
		N/A	(b) For matched studies, give matching criteria and number of exposed and unexposed
Variables	7	6-8	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
Data sources/measurement	8*	6-8	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group
Bias	9	8	Describe any efforts to address potential sources of bias
Study size	10	9	Explain how the study size was arrived at
Quantitative variables	11	6-8	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods	12	8	(a) Describe all statistical methods, including those used to control for confounding
		8-9	(b) Describe any methods used to examine subgroups and interactions
		9	(c) Explain how missing data were addressed
		9	(d) If applicable, explain how loss to follow-up was addressed
		9	(e) Describe any sensitivity analyses
Results			
Participants	13*	9	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed
		9	(b) Give reasons for non-participation at each stage
		N/A	(c) Consider use of a flow diagram
Descriptive data	14*	9	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders
		9	(b) Indicate number of participants with missing data for each variable of interest
		N/A	(c) Summarise follow-up time (eg, average and total amount)
Outcome data	15*	9, 21	Report numbers of outcome events or summary measures over time
Main results	16	22	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear

			which confounders were adjusted for and why they were included
		N/A	(b) Report category boundaries when continuous variables were categorized
		N/A	(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17	24	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses
Discussion			
Key results	18	11	Summarise key results with reference to study objectives
Limitations	19		Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
Interpretation	20	12	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
Generalisability	21	12,13	Discuss the generalisability (external validity) of the study results
Other information			
Funding	22	N/A	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at <http://www.strobe-statement.org>.

Sexual orientation identity in relation to ~~cigarette~~ smoking history and ~~hazardous~~
alcohol use at age 18/19: Cross-sectional associations from wave 6 of the
Longitudinal Study of Young People in England (LSYPE)

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Running head: Sexual orientation, smoking, alcohol use.

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Number of figures, tables: 2. References: [5540](#).

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Abstract

Objectives. ~~Information~~Knowledge about the health behaviours of minority groups is ~~essential~~necessary for ~~addressing~~monitoring health inequalities. ~~We evaluated~~The aim of our ~~study was to evaluate~~ the association between lesbian, gay or bisexual (LGB) sexual orientation identity and ~~two major health behaviours (smoking and alcohol use)~~ in ~~population sample of~~young people in ~~England~~the UK.

Design. Data ~~drawn~~recorded in 2006 and 2009 from ~~wave 6 of~~ the Longitudinal Study of Young People ~~in England~~ (LSYPE ~~L~~) ~~prospective cohort study~~.

Setting. ~~Self-completion~~ Home visits across England involving interviews with each young ~~person and~~ questionnaires ~~during home visits, face-to-face interviews, and web-based questionnaires~~.

Participants. Data from ~~76986656~~ participants (~~3762 men~~3348) with information on sexual orientation identity ~~and health behaviours (at age 18/-19) and health behaviours~~.

Outcome measures. ~~Cigarette smoking~~Smoking history, ~~current~~ alcohol drinking frequency, and ~~risky single occasion~~frequency of drinking (RSOD) ~~alcohol to intoxication~~.

Results. LGB identity was reported by 3.15% of participants (55 gay, 33 lesbian, ~~3534~~ bisexual male, ~~111408~~ bisexual female), ~~3.5% when adjusting for the survey design~~.

Adjusting for ~~a range of covariates~~age, sex, ethnic minority status and parental socio-economic status, identification as lesbian/gay ~~was found to be associated with smoking~~ (OR = ~~2.284~~1.57, 95% CI 1.46, 3.58), alcohol drinking ~~>2 days/week~~18, 2.09) or bisexual (OR = 1.9650, 95% CI 1.24, 3.11), and RSOD21, 1.86) was associated with increased risk of smoking. No association was observed for alcohol drinking frequency. Gay identified male

drinkers were twice as likely to drink to intoxication during every or most drinking episodes (OR = 1.76, 95% CI 1.11, 2.79) more than weekly. Bisexual identity was associated with smoking history (OR = 1.87, 95% CI 1.32, 2.64) and RSOD (OR = 1.02, 95% CI 1.02, 2.79), but not alcohol drinking >2 days/week (OR = 1.17, 95% CI 0.78, 1.77). ~~28, 3.15) compared to heterosexually identified men.~~

Conclusions. In a sample of over ~~7600~~6500 young people age 18/19 in England, lesbian/gay identity is associated smoking, drinking alcohol frequency and RSOD. BisexualLGB identity is associated with smoking and RSOD, but not alcohol drinking frequencya history of cigarette smoking. Young gay males were more likely to demonstrate hazardous drinking patterns. Future studies should identify mechanisms that explain these associations.

Key words: Alcohol Drinking, Alcoholic Intoxication, Cigarette Smoking, Cohort Studies, Sexuality.

Article summary

Article focus

- Studies, mainly from the US, have found an association between lesbian, gay or bisexual (LGB) sexual orientation and cigarette smoking
- ~~Previous LGB orientation may be associated with hazardous alcohol drinking,~~
~~although previous~~ results for alcohol use are mixed, therefore the association should be tested

Key messages

- LGB orientation identity is associated with higher rates of smoking history in a population sample of English 18/-19 year-olds
- ~~Lesbian or For men at age 18-19,~~ gay ~~orientation~~identity is associated with ~~alcohol intoxication on every or most~~ drinking alcohol more than twice per week and risky single occasion drinking episodes
- Bisexual orientation is associated with risky single occasion drinking but not alcohol drinking frequency
- Recording sexual orientation is necessary for describing health inequalities and among young people, there is a very low refusal rate (0.1%)

Strengths and limitations of this study

- This cohort is among the first ~~cohort study~~ in the UK to record sexual orientation identity

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- Smoking history but not current smoking status was recorded at age 18/-19
- ~~Frequency~~~~Alcohol drinking frequency~~ but not quantity of alcohol consumption was ~~available~~~~measured~~

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Introduction

Knowledge about the health behaviours of sexual minority groups is necessary for monitoring health inequalities, developing public health policies, allocating resources and targeting high risk groups for interventions¹⁻³. It is estimated that between 1.5%⁴ and 5%⁵ of the UK population are lesbian, gay, or bisexual (LGB). Estimates tend to be larger when attraction or sexual behaviour are used to define sexual orientation⁶⁻⁸. Additionally, estimates are found to vary by age and ethnic group⁴. Relatively few research studies include a measure of sexual orientation identity, particularly in the UK. As a result, the evidence base on health inequalities for LGB groups is very sparse. Exceptions include the ONS Integrated Household Survey⁴ and the Longitudinal Study of Young People in England⁹ which both included the question for the first time in 2009, and the Scottish Household Survey from 2011.

Cigarette smoking is a prevalent behaviour among young people¹⁰. Many studies have shown an association between LGB orientation and cigarette smoking^{11-13 15 19 25 26 11}, particularly in the US^{3 12-21} but also in different countries²²⁻²⁴. The association is found in men and women and in different age groups, with some exceptions^{23 25-28}, but particularly in young LGB people^{11 29}. Occasionally the association is found to be stronger in women^{23 25-27}. Some studies have used sexual orientation identity as a measure of sexual orientation^{11 13 25 26}, some used same-sex attraction^{18 27} and some used multiple measures^{3 30}.

Alcohol use is also common among young people, but evidence supporting an association between LGB identity and alcohol use is mixed^{3 26 31 32}, with evidence for possible effect modification by sex^{3 26 32}. A systematic review found increased risk of alcohol dependence in men and women and an association between LB identity and alcohol misuse in women only³. A pooled analysis of data from 14 countries found greater alcohol intake and more risky

single occasion drinking in lesbian women but not gay men³², compared to heterosexuals. Studies reporting an association between gay/bisexual male (hereafter, GB men) identity and heavier alcohol use are fewer, with one finding an association specific to those under 50²⁰. There is evidence of a higher prevalence of heavy and potentially hazardous alcohol use among GB men recruited from recreational spaces, gay pride events and web surveys^{33 34}. Several studies have found an association among lesbian/bisexual women (hereafter, LB women) compared to heterosexual women for greater alcohol intake^{27 28 35-37}, alcohol dependence^{37 38}, and risky single occasion drinking^{15 23 37 39-42}. One study found elevated risk of alcohol use among lesbian/bisexual females and 'mostly heterosexual' males, but not gay males⁴². Similar patterns have been found among adolescents in the transition to early adulthood^{29 42 43}, among University students⁴⁰, in midlife³⁵, across the adult age range^{23 38 39}⁴¹, when using behavioural definitions of sexual orientation²⁴ and in different countries including Mexico²² and the UK^{23 24 27 39}.

Introduction

Knowledge about the health behaviours of sexual minority groups is necessary for monitoring health inequalities, developing public health policies, allocating resources and targeting high risk groups for interventions¹⁻³. It is estimated that between 1.5%⁴ and 5%⁵ of the UK population are lesbian, gay, or bisexual (LGB). Estimates vary depending on whether identity, attraction, or sexual behaviour is used as to define sexual orientation⁶⁻⁸. Additionally, estimates are found to vary by age and ethnic group⁴. Relatively few research studies include a measure of sexual orientation, particularly in the UK. Exceptions include the ONS Integrated Household Survey⁴ and the Longitudinal Study of Young People in England⁹ which both included the question for the first time in 2009. As a result, the evidence base on health inequalities for LGB groups is very sparse.

Cigarette smoking remains a prevalent behaviour among young people¹⁰. Many studies have shown an association between LGB orientation and cigarette smoking, particularly in the US^{3-11,19} but also in different countries²⁰⁻²². The association appears to be robust, appearing in men and women and in different age groups, with some exceptions²¹⁻²³⁻²⁵. Occasionally the association is found to be stronger in women²¹⁻²³⁻²⁵. Some of the studies used sexual orientation identity as a measure of sexual orientation¹²⁻²³⁻²⁴, some used same-sex attraction¹⁷⁻²⁵ and some used multiple measures³.

Evidence supporting an association between LGB identity and alcohol use is more mixed, with evidence for possible effect modification by sex. Several studies have found an association among lesbian/bisexual women (hereafter, LB women) compared to heterosexual women for greater alcohol intake²⁵⁻²⁷, alcohol dependence²⁸, and hazardous alcohol drinking such as drunkenness and binge drinking¹⁴⁻²¹⁻²⁹⁻³¹. These associations have been found among adolescents in the transition to early adulthood¹⁴⁻²⁵⁻²⁷, among University students³⁰, in

midlife²⁶, across the adult age range^{21-28,29,31}, when using behavioural definitions of sexual orientation²² and in different countries including Mexico²⁰ and the UK^{21,22,25,29}. A systematic review found increased risk of alcohol dependence in men and women and an association between LB identity and alcohol misuse in women only³. Studies reporting an association between gay/bisexual male (hereafter, GB men) identity and heavier alcohol use are fewer, with one finding an association specific to those under 50¹⁹. There is evidence of a higher prevalence of heavy and potentially hazardous alcohol use among GB men recruited from recreational spaces, gay pride events and web surveys^{32,33}.

The aim of our study was to estimate the association between LGB orientation identity and cigarette smoking history, frequency of ~~alcohol use and frequency of~~ drinking alcohol more than twice per week and risky single occasion drinking, into intoxication, from a population sample of young people (age 18/-19) in England ~~in 2009~~.

Methods

The Longitudinal Study of Young People in England (LSYPE) is a prospective cohort study of English school pupils with repeated annual follow-ups⁹. At recruitment in 2004, ~~participants (N = 15,770) were typically aged 13/14.~~⁹ ~~At recruitment in 2004, participants (N = 15,770) were typically aged 13-14.~~ The cohort was created to evaluate the transitions made by young people from secondary and tertiary education into adulthood. Pupils and parents were invited to participate by letter, using databases of schools to identify ~~identity~~ potential participants. Schools were defined as socio-economically deprived if they fell within the lowest ~~worst~~ quintile of schools ranked according to the proportion of pupils in receipt of school meals. Socio-economically deprived ~~Deprived~~ schools were over-sampled by a factor 1.5 and ethnic minority groups to N=1000 per group. Annual home interview visits incorporated a computer-assisted self-completion element, including questions about

smoking (most recently in 2006, typical age 15/16), alcohol consumption and sexual orientation identity (both in 2009, age 18/19). In 2009, participants were offered either a home visit (face-to-face interview and computer-assisted self-completion questionnaire), telephone interview or web questionnaire.

Sexual orientation identity. Sexual orientation identity was measured in 2009 using the question ‘Which of the following best describes how you think of yourself?’ for the web questionnaire (N = 2690, 40.4%), and for the home visit (N = 848, 12.7%) and telephone interview (N = 3118, 46.8%), the question ‘I will now read out a list of terms people sometimes use to describe how they think of themselves: Heterosexual or straight; Gay or lesbian; Bisexual, Other. As I read the list again please say ‘yes’ when you hear the option that best describes how you think of yourself’. These response options are recommended by the Office of National Statistics⁴. The refusal rate for this question was 0.1% and 0.3% reported for the home visit (N = 848, 12.7%) and telephone interview (N = 3118, 46.8%). ~~These response options are recommended by the Office of National Statistics⁴. The refusal rate for this question was 0.1%, with 0.3% reporting ‘Other’.~~

~~Cigarette~~Regular cigarette smoking. Cigarette smoking was last measured in 2006 (typical age 15/16) with the question ‘Do you ever smoke cigarettes at all?’ followed by six response options (I have never smoked, I have only ever tried smoking once, I used to smoke sometimes but I never smoke a cigarette now, I sometimes smoke cigarettes now but I don’t smoke as many as one a week, I usually smoke between one and six cigarettes a week, I usually smoke more than six cigarettes a week). These were grouped into smoker (sometimes or weekly smoking) versus non-smoker.

Weekly alcohol drinking. Alcohol drinking was measured in 2009 using the question ‘Thinking about the last 12 months, about how often did you usually have an alcoholic

drink?’ with seven response options (Almost every day, Five or six days a week, Three or four days a week, Once or twice a week, Once or twice a month, Once every couple of months, Once or twice a year). Responses were grouped into ‘more than twice per week’ ~~weekly~~’ versus ‘less than twice per week’ ~~weekly~~’ categories.

~~Risky single occasion drinking. Participants were asked Hazardous alcohol drinking. Hazardous alcohol drinking was measured in 2009 in response to a question about alcohol intoxication frequency, ‘On those days when you did have an alcoholic drink, how often would you say you got drunk?’ followed by six response options (Every time, Most times, Around half the time, Less than half the time, Rarely, Never). This information was combined with Hazardous alcohol drinking frequency to identify participants who reported was defined as reporting drunkenness more than 52 times per year, equivalent to drinking every/most of the time, among weekly alcohol to intoxication more than once per week drinkers.~~

Demographic covariates. Age and sex were recorded at baseline in 2004. Pupils self-reported their ethnic group and responses were grouped into five categories: White, Mixed, Indian/Pakistani/Bangladeshi, Black Caribbean/Black African, Chinese; grouped into ‘ethnic minority’ (1) or White (0). The maximum of either parent’s educational attainment was recorded on a six-point scale ranging from ‘no qualification’ (0) to ‘degree or equivalent’ (6). Occupational social class was recorded on an eight-point scale ranging from ‘never worked or long term unemployed’ (1) to ‘higher managerial and professional occupations’ (8), for one or both parents. Parental education attainment and occupational class are both considered indicators of parental socio-economic status (SES).

Statistical analysis. For descriptive analyses, chi-square tests were used to identify significant differences for gay/bisexual vs. heterosexual participants for each study variable.

~~Linear trends were evaluated using logistic regression with heterosexual, bisexual and gay/lesbian categories entered into the model as a continuous parameter.~~ Logistic regression was used to identify whether the mode of survey administration (home visit, telephone interview or web questionnaire) influenced reporting of LGB identity. For the main analysis, logistic regression was used to calculate odds ratios that summarized the relative risk of cigarette smoking, weekly alcohol drinking and hazardous alcohol drinking among weekly alcohol drinkers, according to sexual orientation identity (gay vs. heterosexual and bisexual vs. heterosexual). We minimally adjusted the odds ratios for age and ~~sex, ethnic minority status,~~ and then additionally adjusted the estimates for ethnic minority status, parental education and social class. ~~Ethnicity~~Possible effect modification by sex, parental occupation, parental education and socio-economic status are possible confounding factors, because they may be associated both with mode of survey administration (home visit, telephone interview, web survey) was evaluated by including interactions between sexual identity/orientation and with health behaviours. Wethe possible effect modifier and conducting global tests of ~~interaction. In supplementary analyses, we~~ also combined gay/lesbian and bisexual into a single ‘LGB’ category for additional analysis. Sample weights were used to obtain correct standard errors, allowing for over-sampling of schools with low socio-economic status and for ethnic minority pupils at recruitment. Although statistical power for evaluating possible effect modification by gender and socio-economic status was low, previous studies have shown sex differences (particularly for alcohol use). We therefore ran separate models for males and females in supplementary analyses. In sensitivity analysis, we additionally controlled for mode of survey administration, to evaluate if this influenced the results. All analyses were performed with Stata version 12.1.~~All analyses were performed in Mplus version 7.0.~~

Results

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The analytic sample comprised ~~76986656~~ participants with data on sexual orientation identity, smoking ~~history~~status and alcohol use in addition to covariates (home visit = 12.2%, telephone interview = 47.6%, web questionnaire = 40.1%). Compared to the recruitment sample, ~~In preliminary analyses, we found no significant interaction between sexual orientation identity and adjusting either sex or parental SES for the study design~~smoking and alcohol drinking, leading us to analyse males and females together. For hazardous drinking among alcohol drinkers however, there was a significant interaction with sex. Models for hazardous drinking were therefore conducted separately for males and females. So that non-drinkers could be excluded from analyses of alcohol drinking patterns, a nested sample of 2371 male and 2056 female weekly alcohol drinkers was also used. Compared to at recruitment, the analytic sample contained slightly fewer men (49.47% vs. 53.94%, $p < 0.001$), fewer ethnic minorities (9.96% vs. 14.947.8%, $p < 0.001$), and fewer participants whose parents had less than secondary school level educational qualifications (17.0% with low parental occupational social class (40.5% vs. 29.251.9%, $p < 0.001$) and), fewer participants with parents who were unemployed or had routine occupations (8.1% low levels of parental educational attainment (15.2 vs. 15.530.3%, $p < 0.001$)).

Unweighted descriptive statistics for study variables are shown in Table 1. A total of 3.5% were classified as lesbian, gay or bisexual (55 gay men, 33 lesbian women, 34 bisexual men, 108 bisexual women, 3229 heterosexual men, 3197 heterosexual women). There were fewer women (37.5%) in the 'LG' category than men, but more women (76.0%) in the 'B' category than men. When using sample weights to correct for over-sampling of ethnic minority groups and schools with higher socio-economic deprivation however, the proportion of participants classified as LGB was 3.5% (1.3 LG, 2.2% B).

~~There were a lower proportion of lesbian women (37.5%) compared to gay men (37.5%), but a higher proportion of bisexual women (76.1%) than gay men (23.9%). Lesbian/gay~~

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participants were significantly more likely to report a cigarette smoking history and a hazardous alcohol drinking pattern. A non-significant trend was observed for regular alcohol drinking. There were no significant differences according to ethnic minority status or parental socio-economic status. A significant linear trend was observed however across heterosexual, bisexual, gay/lesbian categories for ethnic minority respondents, who were least likely to endorse LGB response options. Significant linear trends were also observed for cigarette smoking and drunkenness, and a non-significant trend for regular alcohol drinking.

Compared to the web survey, participants completing the telephone interview were more likely to report heterosexual compared to LGB identity (OR = 1.55, 95% CI 1.16, 2.06).

There were no significant differences in reporting heterosexual identity between the home visit and the web survey (OR = 1.16, 95% CI 0.77, 1.73), although this test may be under-powered (there were 33 LGB participants for face-to-face interviews, 86 for telephone interviews and 115 for web questionnaires). In supplementary descriptive analyses (not shown) using sample weights to adjust for the complex survey design, the proportion of participants classified as LGB increased marginally to 3.7% (95% CI 3.2% to 4.2%).

Results from the logistic regression analyses are shown in Table 2, minimally adjusted for age and sex and ethnic minority status and then after further adjustments for ethnic minority status, parental educational attainment and occupational social class (parental SES). Sample weights were used in the models to correct for over-sampling of ethnic minority groups and socio-economically deprived schools at recruitment.

Lesbian or gay participants were more than twice as likely to have a history of cigarette smoking, and bisexual participants nearly twice as likely to have smoked. Adjustment for ethnic minority status and parental SES did not change these results materially. Similar results were found when combining participants into LGB vs. heterosexual.

Participants who identified themselves as gay/lesbian or gay were nearly twice as likely to drink alcohol more than twice a week, even after adjustment for several covariates. There was no association between bisexual identity and drinking alcohol more than twice a week. When combining LGB participants together, the association was weaker but remained significant, in both minimally and fully adjusted models.

Lesbian or gay participants were around 1.8 times more likely to report risky single occasion drinking more than weekly. This association was only slightly weaker in the fully adjusted model. There was no association between bisexual identity and greater than weekly risky single occasion drinking. The combined LGB category was associated with this measure only in the fully adjusted model.

In supplementary analyses separating males and females, the pattern of results for smoking history was very similar for both genders (Table S1), although it was weaker for bisexual males. For alcohol drinking greater than twice per week however, the association was stronger in males than in females. The size of the association was similar for gay men and lesbian women, although confidence intervals were wider for lesbian women. No association was apparent for bisexual men, although there was a non-significant trend toward increased risk for bisexual women. For risky single occasion drinking, the association was stronger and significant in males but a weaker non-significant trend was suggested for females. Bisexual males appeared to be at decreased risk of risky single occasion drinking but this was not significant. These supplementary results should be interpreted with caution, given the small numbers of participants involved. The study may be underpowered to examine effect modification of the odds of smoking ($OR = 1.57$, 95% CI 1.18, 2.08) which was little affected by further adjustment for parental SES ($OR = 1.57$, 95% CI 1.18, 2.09), likely reflecting the lack of association between sexual orientation and health behaviours. SES (Table 1). Identification as bisexual was also associated with smoking ($OR = 1.49$, 95% CI 1.20, 1.84).

which remained after further adjustment (OR = 1.50, 95% CI 1.21, 1.86). In models combining gay/lesbian with bisexual categories, identifying as LGB was associated with smoking (OR = 1.52, 95% CI 1.27, 1.81) which was unchanged after further adjustment (OR = 1.52, 95% CI 1.28, 1.82). In supplementary analyses (not shown), the mode of survey administration was not found to modify the association (p for global interaction > 0.05). Men and women were separated for analysis of alcohol drinking, because sex was found to modify the association between sexual orientation identity and alcohol use. Weekly alcohol drinking was not associated with lesbian identity in women (OR = 1.12, 95% CI 0.81, 1.57) or bisexual identity (OR = 1.00, 95% CI 0.79, 1.26), including after further adjustment for parental SES. Among male weekly alcohol drinkers however, gay (OR = 2.00, 95% CI 1.27, 3.15) and bisexual (OR = 2.00, 95% CI 1.17, 3.44) identities were associated with hazardous alcohol drinking patterns. The association remained for gay identity following adjustment for parental SES (OR = 2.01, 95% CI 1.28, 3.15) but was no longer significant for bisexual identified males (OR = 0.90, 95% CI 0.67, 1.25). There was no significant effect modification by the mode of survey administration (p for global interaction > 0.05). A combined LGB category had no association with hazardous drinking (OR = 1.01, 95% CI 0.87, 1.35). Among female weekly alcohol drinkers, there was no association between lesbian (OR = 0.92, 95% CI 0.55, 1.55) or bisexual (OR = 0.92, 95% CI 0.67, 1.25) or combined LGB (OR = 0.93, 95% CI 0.70, 1.23) identity and hazardous drinking. There was little change in these estimates after additional adjustment for parental SES.

Discussion

In a community-dwelling sample of over ~~76006500~~ young adults in England, men and women reporting a gay/lesbian or bisexual (LGB) identity were around ~~twice as~~~~50% more~~ likely to have a history of cigarette smoking at age 15/16 than those reporting a heterosexual

identity at age 18/19. ~~Lesbian or gay participants were nearly twice as likely to report No association was observed between LGB heterosexual identity and current weekly alcohol drinking alcohol more than twice per week, and more likely to report risky single occasion (for men and women). Among male weekly alcohol drinkers however, identifying as gay/bisexual was associated with a two-fold increase in the likelihood of a hazardous alcohol drinking more often than weekly. Bisexual participants were no more likely to report risky single occasion pattern, defined as drinking than heterosexuals, to intoxication on every/most drinking occasions. There was no association between lesbian identity and hazardous alcohol drinking.~~

Strengths of the study include the large sample which was representative of an entire school year in England at recruitment, ~~typically from the birth years in~~ 1990/91. Data from the UK on sexual orientation identity are exceptionally rare, particularly for young cohorts ^{24 38}. ~~Adjusting for the sample design, ²²⁻²⁸. Around 3.5% of this cohort identified as LGB at age 18/19.~~ The refusal rate for the sexual orientation identity question was low, particularly in the web survey, and differences in how this question was administered were not found to influence results materially. Several major cohort studies in the US ^{41 44} ~~have~~ ^{31 34} ~~have~~ included questions on sexual orientation identity in recent years. In the UK, ~~however~~, data on health inequalities in LGB identified adults has historically come from cross-sectional surveys recruited using snowball sampling ³⁹, ~~gay pride events and internet surveys~~ ^{34 29}, ~~gay pride events and internet surveys~~ ³³ which do not address issues of representativeness fully, even when a heterosexual control group is available ^{39 29}. Recruitment from recreational spaces, particularly before the smoking ban, may have introduced bias into earlier studies. ~~To our knowledge, this the first study to demonstrate that sex modifies the association between sexual orientation identity and drinking alcohol to intoxication in a young UK cohort.~~ The

long-demonstrated association between LGB orientation and smoking ^{3 43 45 463-35-37} appears to have persisted even in this young cohort.

A clear limitation of our study was that smoking status was last assessed in 2006 (age 15/16), two years before sexual orientation was last recorded. Participants may have changed their sexual orientation identity ⁴⁰³⁹ or smoking status between 2006 and 2009, and so the data cannot establish an only allow the association with currenta smoking history to be evaluated. Smoking is not known to influence sexual orientation identity, makingand so we are not concerned about possible reverse causation an unlikely explanation. It is worth noting however, that young people who begin smoking tend to continue into adulthood ⁴⁷³⁸ and two-thirds of smokers begin before age 18 ¹⁰, suggesting that many of those reporting a history of smoking are still current smokers. A second limitation is that¹⁰ -Second, statistical power may not have been available to detect smaller associations, owing to the relatively small proportion of participants in sexual minority groups, particularly for supplementary analyses of men and women separately. A thirdsecond limitation was that aspects of sexual orientation other than identity such as attraction and behaviours ^{8 26 488-24-39} were not recorded. Finally, the percentage of participants identifying as LGB may have been underestimated, particularly if this had not been disclosed to parents, who might have been in the home during telephone and home interviews. Although the refusal rate for the question was low, some participants who identify as LGB might have responded 'heterosexual' for this and other reasons, which might include socially desirable responding. ^{4 49} This would lead to misclassification bias, leading us to have under-estimated the size of any associations found. Results were similar when additionally controlling for mode of survey administration (home visit, telephone, web survey), mitigating concerns that the results are driven by the method of data collection.

Although our finding that LGB orientation is associated with smoking history is largely consistent with other studies, the results concerning drinking alcohol to intoxication differ from prior reports. In several US studies, the association between LGB identity and hazardous alcohol use tends to be stronger among LB women ^{15 23 39-41 44 21-29 31} and in a systematic review, LB identity in women was associated with alcohol dependence and misuse; misuse defined as >21/14 units/week in men/women ^{3 3}. It is important to emphasize however that our study measured alcohol drinking frequency and frequency of drinking to intoxication, not dependence or misuse. Studies from the US involving younger cohorts have reported associations with hazardous alcohol drinking ⁴³ for LGB men ^{30 50} and women ^{36 40}.

Overall, the picture is mixed. Some studies find are stronger association between LG or GB identity and alcohol use in women ^{42 51}, some find a stronger association in men ³¹, and some an association for B but not L women ⁵¹. Our results show an association between LG identity in men and women combined, similar patterns when separating men and women, but with a stronger association in men (Table S1). L or G identity among English youth, but not B identity, is associated with more frequent and riskier single occasion drinking. drinking for LGB men and women ²⁷⁻³⁰. Environmental differences between the UK and US could influence the behaviours of adults who identify as LGB. Such influences might include the age of consent, legal drinking age, laws concerning discrimination, availability of social support and recreational spaces for socializing. A study of students with same-sex sexual experiences found that greater LGB resources were associated with less smoking in women but increased risk of binge drinking in men ⁵². Future international comparisons are necessary, and a pooled meta-analysis of individual participant data (MIPD) would be very valuable.

It is important to identify the underlying mechanisms that connect LGB identity to health behaviours. There is apparently no ~~We are not aware of~~ evidence for genetic covariance between sexual orientation identity and health behaviours, and we suggest that sexual

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orientation itself is unlikely to cause smoking and alcohol use. Several possible mechanisms have been proposed, ~~which-and~~ require further ~~investigation study, most of which remain theoretical~~. The concept of ‘minority stress’ ^{38,28} is often invoked to explain how heterosexism and homophobia are internalised, perhaps leading people to self-medicate psychological distress with cigarettes or alcohol ³⁶. ~~A recent review found support for this theory, particularly in explaining associations with victimisation and substance use~~ ^{53, 27}.

Alternatively, LGB young people may socialize or have socialized in recreational spaces where cigarettes and alcohol are easily available, where peer norms encourage engagement in these behaviours ⁴⁰, or to ³⁰ ~~to~~ appear older than their ~~actual~~ true age, ~~or to signify a sexual preference involving tobacco~~. Concern with appearance could motivate smoking as a weight management strategy. ~~For some, smoking can be sexually arousing, particularly if it is associated with masculinity~~ ⁵⁴ or where there is a sexual attraction to men smoking ⁵⁵. Other commentators have noted the role of the tobacco industry in targeting LGB smokers ^{54, 40}.

Early unhealthy behaviours among LGB young people may influence trajectories toward chronic disease in later life ^{15, 27, 44, 25}. Longitudinal repeated measures data will be necessary in order to identify the antecedents and consequences of unhealthy behaviours for LGB young people in the UK, across the life course. ~~In our view, there is a clear need for a repeated measures cohort study of LGB people~~.

Despite recent equality and diversity legislation and the inclusion of sexual orientation in the National Health Service (NHS) Equality Delivery System, sexual orientation identity is rarely monitored by NHS organisations or measured in epidemiological studies. To improve the evidence base, and support international comparisons, data about sexual orientation should be collected routinely ¹⁻³. ~~In the Integrated Household Survey for example, it will now be possible to consider sexual orientation identity in relation to health status, smoking and subjective wellbeing, among other topics~~ ¹⁻³. Questions about sexual orientation can be added

at low cost and have relatively low refusal rates, particularly among young people. Wider measurement of sexual orientation would ultimately help reduce health inequalities.

Author contributions

Isla Fitchie conducted the literature review. Gareth Hagger-Johnson ~~did performed~~ the analyses. All authors contributed to writing the manuscript.

Data sharing statement

Data are available from the UK Data Archive. ~~Syntax to reproduce the results presented here is available from the corresponding author on request.~~

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References

1. McCabe SE, Hughes TL, Bostwick W, *et al.* Measurement of sexual identity in surveys: implications for substance abuse research. *Arch Sex Behav* 2012;**41**:649-57.

2. Dilley JA, Simmons KW, Boysun MJ, *et al.* Demonstrating the importance and feasibility of including sexual orientation in public health surveys: health disparities in the Pacific Northwest. *Am J Public Health* 2010;**100**:460-67.

3. Lee JGL, Griffin GK, Melvin CL. Tobacco use among sexual minorities in the USA, 1987 to May 2007: a systematic review. *Tob Control* 2009;**18**:275-82.

4. Office for National Statistics. *Measuring Sexual Identity: An Evaluation Report*. 2010. <http://www.ons.gov.uk/ons/rel/ethnicity/measuring-sexual-identity---evaluation-report/2010/index.html> (accessed 28 April 2013).

5. Johnson AM, Mercer CH, Erens B, *et al.* Sexual behaviour in Britain: partnerships, practices, and HIV risk behaviours. *Lancet* 2001;**358**:1835-42.

6. Bostwick WB, Boyd CJ, Hughes TL, *et al.* Dimensions of sexual orientation and the prevalence of mood and anxiety disorders in the United States. *Am J Public Health* 2010;**100**:468-75.

7. Corte C, Matthews A, Kuhn L, *et al.* Dimensions of sexual identity development and alcohol and drug-related risk behavior in sexual minority men. *Alcohol Clin Exp Res* 2010;**34**:241A-41A.

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8. McCabe SE, Hughes TL, Bostwick W, *et al.* Assessment of difference in dimensions of sexual orientation: Implications for substance use research in a college-age population. *J Stud Alcohol* 2005;**66**:620-29.
9. Department for Education and National Centre for Social Research. *Longitudinal Study of Young People in England: Waves One to Seven, 2004-2010* [computer file]. 12th Edition. Colchester, Essex: UK Data Archive [distributor], August 2012. SN: 5545 <http://dx.doi.org/10.5255/UKDA-SN-5545-3> (accessed 14/01/2013)
10. The Health and Social Care Information Centre. *Statistics on Smoking: England, 2010*. <http://www.hscic.gov.uk/pubs/smoking10> (accessed 28 April 2013)
11. Austin SB, Ziyadeh N, Fisher LB, *et al.* Sexual orientation and tobacco use in a cohort study of US adolescent girls and boys. *Arch Pediatr Adolesc Med* 2004;**158**:317-22.
12. Tang H, Greenwood GL, Cowling DW, *et al.* Cigarette smoking among lesbians, gays, and bisexuals: how serious a problem? *Cancer Causes Control* 2004;**15**:797-803.
13. Gruskin EP, Gordon N. Gay/Lesbian sexual orientation increases risk for cigarette smoking and heavy drinking among members of a large Northern California health plan. *BMC Public Health* 2006;**6**:241.
14. Gruskin EP, Greenwood GL, Matevia M, *et al.* Disparities in smoking between the lesbian, gay, and bisexual population and the general population in California. *Am J Public Health* 2007;**97**:1496-502.
15. Marshal MP, Friedman MS, Stall R, *et al.* Individual trajectories of substance use in lesbian, gay and bisexual youth and heterosexual youth. *Addiction* 2009;**104**:974-81.
16. Hatzenbuehler ML, Wieringa NF, Keyes KM. Community-level determinants of tobacco use disparities in lesbian, gay, and bisexual youth: results from a population-based study. *Arch Pediatr Adolesc Med* 2011;**165**:527-32.

17. Pizacani BA, Rohde K, Bushore C, *et al*. Smoking-related knowledge, attitudes and behaviors in the lesbian, gay and bisexual community: a population-based study from the U.S. Pacific Northwest. *Prev Med* 2009;**48**:555-61.

18. Easton A, Jackson K, Mowery P, *et al*. Adolescent same-sex and both-sex romantic attractions and relationships: implications for smoking. *Am J Public Health* 2008;**98**(3):462-7.

19. Corliss H, Wadler B, Jun H-J, *et al*. Sexual-orientation disparities in cigarette smoking in a longitudinal cohort study of adolescents. *Nicotine Tob Res* 2013;**15**:213-22.

20. McKirnan DJ, Tolou-Shams M, Turner L, *et al*. Elevated risk for tobacco use among men who have sex with men is mediated by demographic and psychosocial variables. *Subst Use Misuse* 2006;**41**:1197-208.

21. Austin EL, Irwin JA. Age differences in the correlates of problematic alcohol use among southern lesbians. *J Stud Alcohol Drugs* 2010;**71**:295-8.

22. Ortiz-Hernandez L, Tello BL, Valdes J. The association of sexual orientation with self-rated health, and cigarette and alcohol use in Mexican adolescents and youths. *Soc Sci Med* 2009;**69**:85-93.

23. King M, Nazareth I. The health of people classified as lesbian, gay and bisexual attending family practitioners in London: a controlled study. *BMC Public Health* 2006;**6**:127.

24. Mercer CH, Bailey JV, Johnson AM, *et al*. Women who report having sex with women: British national probability data on prevalence, sexual behaviors, and health outcomes. *Am J Public Health* 2007;**97**:1126-33.

25. Trocki KF, Drabble LA, Midanik LT. Tobacco, marijuana, and sensation seeking: comparisons across gay, lesbian, bisexual, and heterosexual groups. *Psychol Addict Behav* 2009;**23**:620-31.

26. Lindley LL, Walsemann KM, Carter JW, Jr. The association of sexual orientation measures with young adults' health-related outcomes. *Am J Public Health* 2012;**102**:1177-85.

27. Needham BL. Sexual attraction and trajectories of mental health and substance use during the transition from adolescence to adulthood. *J Youth Adolesc* 2012;**41**:179-90.
28. Needham BL, Austin EL. Sexual orientation, parental support, and health during the transition to young adulthood. *J Youth Adolesc* 2010;**39**:1189-98.
29. Tucker JS, Ellickson PL, Klein DJ. Understanding differences in substance use among bisexual and heterosexual young women. *Womens Health Issues* 2008;**18**:387-98.
30. Brewster KL, Tillman KH. Sexual Orientation and Substance Use Among Adolescents and Young Adults. *Am J Public Health* 2012;**102**:1168-76.
31. Caldwell LL, Kivel BD, Smith EA, *et al*. The leisure context of adolescents who are lesbian, gay male, bisexual and questioning their sexual identities: An exploratory study. *J Leis Res* 1998;**30**:341-55.
32. Bloomfield K, Wicki M, Wilsnack S, *et al*. International Differences in Alcohol Use According to Sexual Orientation. *Subst Abus* 2011;**32**:210-19.
33. Keogh P, Reid D, Bourne A, *et al*. *Wasted opportunities: Problematic alcohol and drug use among gay men and bisexual men*. London: Sigma Research, 2009.
34. Hickson, F. *Consuming passions: Findings from the United Kingdom gay men's sex survey 2005*. Sigma Research, 2007.
35. Case P, Austin SB, Hunter DJ, *et al*. Sexual orientation, health risk factors, and physical functioning in the Nurses' Health Study II. *J Womens Health* 2004;**13**:1033-47.
36. Corliss HL, Rosario M, Wypij D, *et al*. Sexual orientation disparities in longitudinal alcohol use patterns among adolescents findings from the Growing Up Today Study. *Arch Pediatr Adolesc Med* 2008;**162**:1071-78.
37. King M, Semlyen J, Tai S, *et al*. A systematic review of mental disorder, suicide, and deliberate self harm in lesbian, gay and bisexual people. *BMC Psychiatry* 2008;**8**:70.
38. Chakraborty A, McManus S, Brugha TS, *et al*. Mental health of the non-heterosexual population of England. *Br J Psychiatry* 2011;**198**:143-48.

39. King M, McKeown E, Warner J, *et al*. Mental health and quality of life of gay men and lesbians in England and Wales - Controlled, cross-sectional study. *Br J Psychiatry* 2003;**183**:552-58.

40. Talley AE, Sher KJ, Littlefield AK. Sexual orientation and substance use trajectories in emerging adulthood. *Addiction* 2010;**105**:1235-45.

41. Boehmer U, Miao X, Linkletter C, *et al*. Adult health behaviors over the life course by sexual orientation. *Am J Public Health* 2012;**102**:292-300.

42. Ziyadeh NJ, Prokop LA, Fisher LB, *et al*. Sexual orientation, gender, and alcohol use in a cohort study of US adolescent girls and boys. *Drug Alcohol Depend* 2007;**87**:119-30.

43. Marshal MP, Friedman MS, Stall R, *et al*. Sexual orientation and adolescent substance use: a meta-analysis and methodological review. *Addiction* 2008;**103**:546-56.

44. Corliss H, Wadler B, Jun H-J, *et al*. Sexual-orientation disparities in cigarette smoking in a longitudinal cohort study of adolescents. *Nicotine Tob Res* 2013;**15**:213-22.

45. Blosnich J, Lee JG, Horn K. A systematic review of the aetiology of tobacco disparities for sexual minorities. *Tob Control* 2013;**22**:66-73.

46. Ryan H, Wortley PM, Easton A, *et al*. Smoking among lesbians, gays, and bisexuals: a review of the literature. *Am J Prev Med* 2001;**21**:142-9.

47. Gervais A, O'Loughlin J, Meshefedjian G, *et al*. Milestones in the natural course of onset of cigarette use among adolescents. *CMAJ* 2006;**175**:255-61.

48. Talley AE, Sher KJ, Steinley D, *et al*. Patterns of alcohol use and consequences among empirically derived sexual minority subgroups. *J Stud Alcohol Drugs* 2012;**73**:290-302.

49. Mitchell K, Wellings K, Elam G, *et al*. How can we facilitate reliable reporting in surveys of sexual behaviour? Evidence from qualitative research. *Cult Health Sex* 2007;**9**:519-31.

50. Hatzenbuehler ML, Corbin WR, Fromme K. Trajectories and determinants of alcohol use among LGB young adults and their heterosexual peers: Results from a prospective study. *Dev Psychol* 2008;**44**:81-90.

51. Udry JR, Chantala K. Risk assessment of adolescents with same-sex relationships. *J Adolesc Health* 2002;**31**:84-92.
52. Eisenberg ME, Wechsler H. Social influences on substance-use behaviors of gay, lesbian, and bisexual college students: findings from a national study. *Soc Sci Med* 2003;**57**:1913-23.
53. Collier KL, van Beusekom G, Bos HMW, *et al*. Sexual Orientation and Gender Identity/Expression Related Peer Victimization in Adolescence: A Systematic Review of Associated Psychosocial and Health Outcomes. *J Sex Res* 2013;**50**:299-317.
54. Smith EA, Malone RE. The outing of Philip Morris: advertising tobacco to gay men. *Am J Public Health* 2003;**93**:988-93.
55. Aronsson H, Lind J, Ghirlanda S, *et al*. Parental influences on sexual preferences: The case of attraction to smoking. *Journal of Evolutionary Psychology* 2011;**9**:21-41.

1. McCabe SE, Hughes TL, Bostwick W, Morales M, Boyd CJ. Measurement of Sexual Identity in Surveys: Implications for Substance Abuse Research. *Archives of Sexual Behavior* 2012;41(3):649-57.

2. Dilley JA, Simmons KW, Boysun MJ, Pizacani BA, Stark MJ. Demonstrating the Importance and Feasibility of Including Sexual Orientation in Public Health Surveys: Health Disparities in the Pacific Northwest. *American Journal of Public Health* 2010;100(3):460-67.

3. King M, Semlyen J, Tai S, Killaspy H, Osborn D, Popelyuk D, et al. A systematic review of mental disorder, suicide, and deliberate self harm in lesbian, gay and bisexual people. *BMC Psychiatry* 2008;8(1):70.

4. Office of National Statistics. Measuring Sexual Identity: An Evaluation Report. London; 2010.

5. Johnson AM, Mercer CH, Erens B, Copas AJ, McManus S, Wellings K, et al. Sexual behaviour in Britain: partnerships, practices, and HIV risk behaviours. *The Lancet* 2001;358(9296):1835-42.

6. Bostwick WB, Boyd CJ, Hughes TL, McCabe SE. Dimensions of Sexual Orientation and the Prevalence of Mood and Anxiety Disorders in the United States. *American Journal of Public Health* 2010;100(3):468-75.

7. Corte C, Matthews A, Kuhn L, Garofalo R, Bird J, Johnson A. Dimensions of sexual identity development and alcohol and drug-related risk behavior in sexual-minority men. *Alcoholism Clinical and Experimental Research* 2010;34(6):241A-41A.

8. McCabe SE, Hughes TL, Bostwick W, Boyd CJ. Assessment of difference in dimensions of sexual orientation: Implications for substance use research in a college-age population. *Journal of Studies on Alcohol* 2005;66(5):620-29.

9. Service EaSD. Longitudinal Study of Young People in England: Waves One to Seven. In: ESDS, editor. Colechester; 2011.

10. Health and Social Care Information Centre. Statistics on smoking: England 2010. London: National Health Service; 2011.

11. Tang H, Greenwood GL, Cowling DW, Lloyd JC, Roeseler AG, Bal DG. Cigarette smoking among lesbians, gays, and bisexuals: how serious a problem? (United States). *Cancer Causes Control* 2004;15(8):797-803.

12. Gruskin EP, Gordon N. Gay/Lesbian sexual orientation increases risk for cigarette smoking and heavy drinking among members of a large Northern California health plan. *BMC Public Health* 2006;6.

13. Gruskin EP, Greenwood GL, Matevia M, Pollack LM, Bye LL. Disparities in smoking between the lesbian, gay, and bisexual population and the general population in California. *Am J Public Health* 2007;97(8):1496-502.

14. Marshal MP, Friedman MS, Stall R, Thompson AL. Individual trajectories of substance use in lesbian, gay and bisexual youth and heterosexual youth. *Addiction* 2009;104(6):974-81.

15. Hatzenbuehler ML, Wieringa NF, Keyes KM. Community level determinants of tobacco use disparities in lesbian, gay, and bisexual youth: results from a population-based study. *Arch Pediatr Adolesc Med* 2011;165(6):527-32.

16. Pizacani BA, Rohde K, Bushore C, Stark MJ, Maher JE, Dilley JA, et al. Smoking-related knowledge, attitudes and behaviors in the lesbian, gay and bisexual community: a population-based study from the U.S. Pacific Northwest. *Prev Med* 2009;48(6):555-61.

17. Easton A, Jackson K, Mowery P, Comeau D, Sell R. Adolescent same-sex and both-sex romantic attractions and relationships: implications for smoking. *Am J Public Health* 2008;98(3):462-7.

18. Corliss H, Wadler B, Jun H J, Rosario M, Wypij D, Frazier L, et al. Sexual orientation disparities in cigarette smoking in a longitudinal cohort study of adolescents. *Nicotine & Tobacco Research* in press.
19. McKirnan DJ, Tolou-Shams M, Turner L, Dyslin K, Hope B. Elevated risk for tobacco use among men who have sex with men is mediated by demographic and psychosocial variables. *Subst Use Misuse* 2006;41(8):1197-208.
20. Ortiz Hernandez L, Tello BL, Valdes J. The association of sexual orientation with self-rated health, and cigarette and alcohol use in Mexican adolescents and youths. *Soc Sci Med* 2009;69(1):85-93.
21. King M, Nazareth I. The health of people classified as lesbian, gay and bisexual attending family practitioners in London: a controlled study. *BMC Public Health* 2006;6:127.
22. Mercer CH, Bailey JV, Johnson AM, Erens B, Wellings K, Fenton KA, et al. Women who report having sex with women: British national probability data on prevalence, sexual behaviors, and health outcomes. *Am J Public Health* 2007;97(6):1126-33.
23. Trocki KF, Drabble LA, Midanik LT. Tobacco, marijuana, and sensation seeking: comparisons across gay, lesbian, bisexual, and heterosexual groups. *Psychol Addict Behav* 2009;23(4):620-31.
24. Lindley LL, Walsemann KM, Carter JW, Jr. The association of sexual orientation measures with young adults' health related outcomes. *Am J Public Health* 2012;102(6):1177-85.
25. Needham BL. Sexual attraction and trajectories of mental health and substance use during the transition from adolescence to adulthood. *J Youth Adolescence* 2012;41(2):179-90.
26. Case P, Austin SB, Hunter DJ, Manson JE, Malspeis S, Willett WC, et al. Sexual orientation, health risk factors, and physical functioning in the Nurses' Health Study II. *Journal of Womens Health* 2004;13(9):1033-47.
27. Corliss HL, Rosario M, Wypij D, Fisher LB, Austin SB. Sexual Orientation Disparities in Longitudinal Alcohol Use Patterns Among Adolescents Findings From the Growing Up Today Study. *Archives of Pediatrics & Adolescent Medicine* 2008;162(11):1071-78.
28. Chakraborty A, McManus S, Brugha TS, Bebbington P, King M. Mental health of the non heterosexual population of England. *British Journal of Psychiatry* 2011;198(2):143-48.
29. King M, McKeown E, Warner J, Ramsay A, Johnson K, Cort C, et al. Mental health and quality of life of gay men and lesbians in England and Wales—Controlled, cross-sectional study. *British Journal of Psychiatry* 2003;183:552-58.
30. Talley AE, Sher KJ, Littlefield AK. Sexual orientation and substance use trajectories in emerging adulthood. *Addiction* 2010;105(7):1235-45.
31. Boehmer U, Miao X, Linkletter C, Clark MA. Adult Health Behaviors Over the Life Course by Sexual Orientation. *American Journal of Public Health* 2012;102(2):292-300.
32. Keogh P, Reid D, Bourne A, Weatherburn P, Hickson F, Jessup K, et al. Wasted opportunities: Problematic alcohol and drug use among gay men and bisexual men. London: Sigma Research, 2009.
33. Sigma research. *Consuming passions: findings from the United Kingdom Gay Men's Sex Survey 2005*. London: Sigma Research, 2008.
34. Dilley JA, Maher JE, Boysun MJ, Pizacani BA, Mosback CH, Rohde K, et al. Response letter to: Tang H, Greenwood GL, Cowling DW, Lloyd JC, Roeseler AG, Bal DG. Cigarette smoking among lesbians, gays, and bisexuals: how serious a problem? *Cancer Causes Control* 2005;16(9):1133-4.

35. Blossnich J, Lee JG, Horn K. A systematic review of the aetiology of tobacco disparities for sexual minorities. *Tob Control* 2011.

36. Marshal MP, Friedman MS, Stall R, King KM, Miles J, Gold MA, et al. Sexual orientation and adolescent substance use: a meta-analysis and methodological review. *Addiction* 2008;103(4):546-56.

37. Ryan H, Wortley PM, Easton A, Pederson L, Greenwood G. Smoking among lesbians, gays, and bisexuals: a review of the literature. *Am J Prev Med* 2001;21(2):142-9.

38. Gervais A, O'Loughlin J, Meshefedjian G, Bancej C, Tremblay M. Milestones in the natural course of onset of cigarette use among adolescents. *Canadian Medical Association Journal* 2006;175(3):255-61.

39. Talley AE, Aranda F, Hughes TL, Marshal MP, Sher KJ. Does differential endorsement of dimensions of sexual orientation relate to problematic drinking and depressive symptoms? *Alcoholism Clinical and Experimental Research* 2012;36:218A-18A.

40. Smith EA, Malone RE. The outing of Philip Morris: advertising tobacco to gay men. *Am J Public Health* 2003;93(6):988-93.

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Table 1. Descriptive statistics for study variables (unweighted), according to sexual orientation identity in 2009, N(%) ~~or mean(SD)~~

Study variables (N = 7698) ^a N=6656 ^a	Lesbian or gay	Bisexual	Heterosexual	p ^c	p ^d	p ^e
	(n = 88, 1.1%)	(n = 146, 2.1%)	(n = 7464, 97.0%)			
Female	33 (37.5)	111 (76.0)	3792 (50.3)	0.001	0.014	<0.001
Ethnic minority ^f	12 (13.6)	12 (8.1)	2112 (28.3)	<0.001	0.003	<0.001
Parental education (less than secondary degree level)	13 (14.3)	26 (17.8)	1715 (23.0)	0.026	0.077	0.14
Parental occupation (routine or unemployed)	10 (11.2)	18 (12.3)	900 (12.3)	0.974	0.843	0.923
History of cigarette smoking (age 15/16)	35 (39.8)	60 (41.4)	1649 (22.1)	<0.001	<0.001	<0.001
Alcohol drinking >2 days/week (Weekly alcohol drinker (2009, age 18/19))	33 (37.5)	38 (26.0)	1467 (19.7)	<0.001	<0.001	0.057
Risky single occasion% of alcohol drinkers with	40 (45.5)	48 (32.9)	1985 (26.6)	<0.001	<0.001	0.090

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hazardous drinking (pattern (2009- age 18/19)	(73.1)	(51.4)
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^aAnalytic sample (N = ~~76986656~~) comprises participants with available data on age, sex, ethnic group, parental education, ~~and~~ occupational social class, smoking ~~history(2004)~~ and alcohol use, ~~-(2004 and 2009)-~~.

^bUnweighted frequency.

^cp value for ~~gay/lesbian/gay/bisexual~~ -vs. heterosexual, ~~-(chi-square test)-~~.

^dp value for ~~linear trend across~~ gay/lesbian ~~vs., bisexual and~~ heterosexual, ^ep bisexual vs. heterosexual, ^fUnweighted frequency (ethnic minority groups were over-sampled).:-

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Table 2. Association between sexual orientation identity and smoking, alcohol drinking >2 days/week and risky single occasion drinking

N=7698, History Weekly alcohol Alcohol Hazardous alcohol drinking > Weekly risky single occasion Hazardous alcohol drinking vs. of drinker >2 days/week <=pattern cigarette vs. <=2 days/week or neverpattern (among female weekly drinkers) smoking (among male weekly drinkers) vs. non- Cigarette smoker

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	N=6656 ^a		N=6656 ^a		N=2371		N=2056	
	Minimally	Fully	Minimally	Fully	Minimally adjusted ^b	Fully	Minimally	Fully
	adjusted ^b	-adjusted ^c	adjusted ^b	-adjusted ^c		-adjusted ^c	adjusted ^b	adjusted ^c
<u>Model 1</u>								
Lesbian or	1.57	1.57	1.99***	1.99**	2.00	2.01	0.92	0.92

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gay	(1.18, 2.34)**	(1.18, 2.23)*	(1.2	(1.0	(1.82***	(1.80*	(0.55, 1.55	(0.54, 1.55
(vs.	*	*	(0.81, 1.28	(0.79, 1.25, 3.1753)	(1.16, 2.8427, 3.15)	(1.13,))
heterosexual	(1.50,	(1.42,	3.0957)			2.8628, 3.15		
)	3.6508)	3.5109)						
Bisexual	1.94***49	1.84**50	1.00	0.97	2.00	0.90	0.92	0.92
(vs.	(1.37,	(1.30,	(0.79, 1.26	(0.76, 1.2	(1.17, 3.44	(0.53, 1.11	(0.67, 1.04	(0.68, 1.26
heterosexual	2.7520, 1.84)	2.6121, 1.86	(0.84,	0)	(0.76, 1.6156)	(0.71, 2.8625))
)			1.89)	(0.79				
			1.8122)					
<i>Model 2</i>								
Lesbian, gay	2.08***	1.98***52	1.53***	1.48*	1.09	1.09	0.93	0.92
or bisexual	(1.57, 2.7652	(1.49,	(0.4	(0.4	(0.87, 1.35	(0.88, 1.35)	(0.70, 1.29	(0.70, 1.22
(vs.	(1.27, 1.84)	2.6328, 1.82	(0.86, 1.15	(0.83, 1.10, 1.9923)	*		(0.96, 1.7423))
heterosexual			2.0327)		(1.01,			
)					1.79)			

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Values shown are odds ratios (95% confidence intervals). *** = $p < 0.001$, ** = $p < 0.01$, * = $p < 0.05$.^a Analytic sample (comprises participants with available data on age, sex, ethnic group, parental education and occupational social class, smoking and alcohol use. Sample weights are applied.

^b Adjusted for age and sex. ^c Adjusted for age, sex, ethnic minority status, parental educational attainment, parental occupational social class.

Table S1. Association between sexual orientation identity and smoking, alcohol drinking >2 days/week and risky single occasion drinking

	History of cigarette smoking		Alcohol drinking >2 days/week		>Weekly risky single occasion drinking	
	vs. non-smoker		vs. <=2 days/week or never		vs. <=weekly	
	Minimally adjusted ^b	Fully adjusted ^c	Minimally adjusted ^b	Fully adjusted ^c	Minimally adjusted ^b	Fully adjusted ^c
<i>Males (n = 3762)</i>						
Gay	2.38**	2.31**	1.92*	1.95*	2.13*	2.15*
(vs. heterosexual)	(1.31, 4.33)	(1.27, 4.20)	(1.10, 3.35)	(1.07, 3.55)	(1.21, 3.77)	(1.19, 3.87)
Bisexual	1.93	1.88	1.04	0.95	0.67	0.61
(vs. heterosexual)	(0.92, 4.09)	(0.88, 4.00)	(0.49, 2.20)	(0.44, 2.07)	(0.30, 1.46)	(0.27, 1.36)
<i>Females (n = 3936)</i>						
Gay	2.30*	2.14*	2.10	2.06	1.40	1.34
(vs. heterosexual)	(1.14, 4.62)	(1.04, 4.38)	(1.00, 4.42)	(0.84, 2.15)	(0.68, 2.88)	(0.63, 2.86)
Bisexual	1.93**	1.82*	1.39	1.35	1.32	1.26

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(vs. heterosexual) (1.30, 2.87) (1.23, 2.69) (0.87, 2.21) (0.84, 2.15) (0.87, 2.00) (0.82, 1.94)

Values shown are odds ratios (95% confidence intervals). *** = $p < 0.001$, ** = $p < 0.01$, * = $p < 0.05$.^a Analytic sample (comprises participants with available data on age, sex, ethnic group, parental education and occupational social class, smoking and alcohol use. Sample weights are applied.

^b Adjusted for age. ^c Adjusted for age, ethnic minority status~~sex~~, parental educational attainment, parental occupational social class.

~~sex~~, ethnic minority status.

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**Sexual orientation identity in relation to smoking history
and alcohol use at age 18/19: Cross-sectional associations
from the Longitudinal Study of Young People in England
(LSYPE)**

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Sexual orientation identity in relation to smoking history and alcohol use at age 18/19: Cross-sectional associations from the Longitudinal Study of Young People in England (LSYPE)

Running head: Sexual orientation, smoking, alcohol use.

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Abstract

Objectives. Information about the health behaviours of minority groups is essential for addressing health inequalities. We evaluated the association between lesbian, gay or bisexual (LGB) sexual orientation identity and smoking and alcohol use in young people in England.

Design. Data drawn from wave 6 of the Longitudinal Study of Young People in England (LSYPE).

Setting. Self-completion questionnaires during home visits, face-to-face interviews, and web-based questionnaires.

Participants. Data from 7698 participants (3762 men) with information on sexual orientation identity and health behaviours at age 18/19.

Outcome measures. Cigarette smoking history, alcohol drinking frequency, and risky single occasion drinking (RSOD).

Results. LGB identity was reported by 3.1% of participants (55 gay, 33 lesbian, 35 bisexual male, 111 bisexual female), 3.5% when adjusting for the survey design. Adjusting for a range of covariates, identification as lesbian/gay was found to be associated with smoking (OR = 2.23, 95% CI 1.42, 3.51), alcohol drinking >2 days/week (OR = 1.99, 95% CI 1.25, 3.17), and RSOD (OR = 1.80, 95% CI 1.13, 2.86) more than weekly. Bisexual identity was associated with smoking history (OR = 1.84, 95% CI 1.30, 2.61) but not alcohol drinking >2 days/week (OR = 1.20, 95% CI 0.79, 1.81) or RSOD (OR = 1.04, 95% CI 0.71, 2.86).

Conclusions. In a sample of over 7600 young people age 18/19 in England, lesbian/gay identity is associated with cigarette smoking, drinking alcohol frequency and RSOD. Bisexual identity is associated with smoking but not RSOD or frequent alcohol drinking.

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Key words: Alcohol Drinking, Alcoholic Intoxication, Cigarette Smoking, Cohort Studies,
Sexuality.

For peer review only

Article summary

Article focus

- Studies, mainly from the US, have found an association between lesbian, gay or bisexual (LGB) sexual orientation and cigarette smoking
- Previous results for alcohol use are mixed, therefore the association should be evaluated

Key messages

- LGB orientation identity is associated with higher rates of smoking history in a population sample of English 18/19 year-olds, compared to heterosexual or 'straight' identity
- Lesbian or gay (compared to heterosexual) identity is associated with increased risk of drinking alcohol more than twice per week and risky single occasion drinking
- Bisexual (compared to heterosexual) identity is associated with smoking but not alcohol drinking frequently or risky single occasion drinking
- Recording sexual orientation is necessary for describing health inequalities and among young people, there is a very low refusal rate (0.1%)

Strengths and limitations of this study

- This cohort is among the first in the UK to record sexual orientation identity
- Smoking history was available but not current smoking status at age 18/19
- Data on the quantity of alcohol typically consumed was not available
- Numbers of LGB participants were small, which could be addressed by a large prospective cohort study of LGB people

Introduction

Knowledge about the health behaviours of sexual minority groups is necessary for monitoring health inequalities, developing public health policies, allocating resources and targeting high risk groups for interventions.^{1 2} It is estimated that between 1.5%³ and around 5%⁴ of the UK population are lesbian, gay, or bisexual (LGB). Estimates can vary depending on whether identity, sexual behaviour or same-sex attraction are used to define sexual orientation.^{3 5 6} Additionally, estimates can vary by age and ethnic group.³ Relatively few research studies include a measure of sexual orientation identity, particularly in the UK. As a result, the evidence base on health inequalities experienced by LGB people is very sparse. Exceptions include the National Attitudes of Sexual Attitudes and Lifestyles (NATSAL; 1990-91, 1999-01, 2010-12), National Statistics Opinions Survey (in 2008-09), ONS Integrated Household Survey (from 2009), the Longitudinal Study of Young People in England (from 2009), Health Survey for England (from 2010) and the Scottish Health Survey (from 2008).

Cigarette smoking is a prevalent behaviour among young people.⁷ Many studies have shown an association between LGB orientation and cigarette smoking,⁸⁻¹³ mostly in the US but also in Mexico¹⁴ and the UK.¹⁵ The association is usually found in men and women and in different age groups, particularly in young LGB people.^{8 14} Occasionally the association is found to be stronger in women.¹⁵ Some studies used sexual orientation identity as a measure of sexual orientation, some used same-sex attraction and some used multiple measures.¹¹

Alcohol use is also common among young people, but evidence supporting an association between LGB identity and alcohol use is mixed,¹⁶ with evidence for possible effect modification by sex. A systematic review found increased risk of alcohol dependence in men and women and an association between LB identity and alcohol misuse in women only.¹⁷ A pooled analysis of data from 14 countries found greater alcohol intake and more risky single occasion drinking (RSOD) in lesbian women but not gay men, compared to heterosexuals.¹⁶ Studies reporting an association

between gay/bisexual male (hereafter, GB men) identity and heavier alcohol use are fewer. One study found an association specific in relation to GB men under 50.¹⁸ There is evidence of a higher prevalence of heavy and potentially hazardous alcohol use among GB men recruited from recreational spaces, gay pride events and web surveys.¹⁹

Several studies have found an association among lesbian/bisexual women (hereafter, LB women) compared to heterosexual women for greater alcohol intake,^{6 20 21} alcohol dependence,^{17 22} and risky single occasion drinking.^{15 23} One study found elevated risk of alcohol use among lesbian/bisexual females and 'mostly heterosexual' males, but not gay males.²⁴ Similar patterns have been found among adolescents in the transition to early adulthood,²⁴⁻²⁶ among University students,²⁷ in midlife, across the adult age range,^{15 18 23} when using behavioural definitions of sexual orientation⁶ and in different countries including Mexico¹⁴ and the UK.^{6 15 23 28}

The aim of our study was to estimate the association between LGB orientation identity and cigarette smoking history, frequency of drinking alcohol more than twice per week and RSOD, in young people (age 18/19) in England.

Methods

The Longitudinal Study of Young People in England (LSYPE) is a prospective cohort study of English school pupils with repeated annual follow-ups.²⁹ At recruitment in 2004, participants (N = 15,770) were typically aged 13/14. The cohort was created to evaluate the transitions made by young people from secondary and tertiary education into adulthood. Pupils and parents were invited to participate by letter, using databases of schools to identify potential participants. Schools were defined as socio-economically deprived if they fell within the lowest quintile of schools ranked according to the proportion of pupils in receipt of school meals. Socio-economically deprived schools were over-sampled by a factor 1.5 and ethnic minorities to achieve N=1000 per ethnic group. Annual home interview visits incorporated a computer-assisted self-completion element,

including questions about smoking (most recently in 2006, typical age 15/16), alcohol consumption and sexual orientation identity (both in 2009, age 18/19). In 2009, participants were offered either a home visit (face-to-face interview and computer-assisted self-completion questionnaire), telephone interview or web questionnaire.

Sexual orientation identity. Sexual orientation identity was measured in 2009 using the question ‘Which of the following best describes how you think of yourself?’ for the web questionnaire (N = 2690, 40.4%), and for the home visit (N = 848, 12.7%) and telephone interview (N = 3118, 46.8%), ‘I will now read out a list of terms people sometimes use to describe how they think of themselves: Heterosexual or straight; Gay or lesbian; Bisexual, Other. As I read the list again please say ‘yes’ when you hear the option that best describes how you think of yourself’. These response options are recommended by the Office of National Statistics.³ The refusal rate for this question was 0.1% and 0.3% reported ‘Other’.

Cigarette smoking. Cigarette smoking was last measured in 2006 (typical age 15/16) with the question ‘Do you ever smoke cigarettes at all?’ followed by six response options (I have never smoked, I have only ever tried smoking once, I used to smoke sometimes but I never smoke a cigarette now, I sometimes smoke cigarettes now but I don't smoke as many as one a week, I usually smoke between one and six cigarettes a week, I usually smoke more than six cigarettes a week). These were grouped into smoker (sometimes or weekly smoking) versus non-smoker.

Weekly alcohol drinking. Alcohol drinking was measured in 2009 using the question ‘Thinking about the last 12 months, about how often did you usually have an alcoholic drink?’ with seven response options (Almost every day, Five or six days a week, Three or four days a week, Once or twice a week, Once or twice a month, Once every couple of months, Once or twice a year). Responses were grouped into ‘more than twice per week’ versus ‘less than twice per week’.

Risky single occasion drinking. Participants were asked, ‘On those days when you did have an alcoholic drink, how often would you say you got drunk?’ followed by six response options (Every

time, Most times, Around half the time, Less than half the time, Rarely, Never). This information was combined with alcohol drinking frequency to identify participants who reported drunkenness more than 52 times per year, equivalent to drinking alcohol to intoxication more than once per week.

Demographic covariates. Age and sex were recorded at baseline in 2004. Pupils self-reported their ethnic group and responses were grouped into five categories: White, Mixed, Indian/Pakistani/Bangladeshi, Black Caribbean/Black African, Chinese; grouped into 'ethnic minority' (1) or White (0). The maximum of either parent's educational attainment was recorded on a six-point scale ranging from 'no qualification' (0) to 'degree or equivalent' (6). Occupational social class was recorded on an eight-point scale ranging from 'never worked or long term unemployed' (1) to 'higher managerial and professional occupations' (8), for one or both parents. Parental education attainment and occupational class are both considered indicators of parental socio-economic status (SES).

Statistical analysis. For descriptive analyses, chi-square tests were used to identify significant differences for gay/bisexual vs. heterosexual participants for each study variable. Logistic regression was used to identify whether the mode of survey administration (home visit, telephone interview or web questionnaire) influenced reporting of LGB identity. For the main analysis, logistic regression was used to calculate odds ratios that summarized the relative risk of cigarette smoking, weekly alcohol drinking and hazardous alcohol drinking among weekly alcohol drinkers, according to sexual orientation identity (gay vs. heterosexual and bisexual vs. heterosexual). We minimally adjusted the odds ratios for age and sex, and then additionally adjusted the estimates for ethnic minority status, parental education and social class. Ethnicity and socio-economic status are possible confounding factors, because they may be associated both with sexual identity and with health behaviours. We also combined gay/lesbian and bisexual into a single 'LGB' category for additional analysis. Sample weights were used to obtain correct standard errors, allowing for over-sampling of schools with low socio-economic status and for ethnic minority pupils at recruitment.

Although statistical power for evaluating possible effect modification by gender and socio-economic status was low, previous studies have shown sex differences (particularly for alcohol use). We therefore ran separate models for males and females in supplementary analyses. In sensitivity analysis, we additionally controlled for mode of survey administration, to evaluate if this influenced the results. All analyses were performed with Stata version 12.1.

Results

The analytic sample comprised 7698 participants with data on sexual orientation identity, smoking history and alcohol use in addition to covariates (home visit = 12.2%, telephone interview = 47.6%, web questionnaire = 40.1%). Compared to the recruitment sample and adjusting for the study design, the analytic sample contained slightly fewer men (49.4% vs. 53.9%, $p < 0.001$), fewer ethnic minorities (9.9% vs. 14.9%, $p < 0.001$), fewer participants whose parents had less than secondary school level educational qualifications (17.0% vs. 29.2%, $p < 0.001$) and fewer participants with parents who were unemployed or had routine occupations (8.1% vs. 15.5%, $p < 0.001$).

Unweighted descriptive statistics for study variables are shown in Table 1. A total of 3% were classified as lesbian, gay or bisexual (55 gay men, 33 lesbian women, 34 bisexual men, 108 bisexual women, 3229 heterosexual men, 3197 heterosexual women). There were fewer women (37.5%) in the ‘LG’ category than men, but more women (76.0%) in the ‘bisexual’ category than men. When using sample weights to correct for over-sampling of ethnic minority groups and schools with higher socio-economic deprivation however, the proportion of participants classified as LGB was 3.5% (1.3% LG, 2.2% bisexual).

Compared to the web survey, participants completing the telephone interview were more likely to report heterosexual compared to LGB identity (OR = 1.55, 95% CI 1.16, 2.06). There were no significant differences in reporting heterosexual identity between the home visit and the web survey (OR = 1.16, 95% CI 0.77, 1.73), although this test may be under-powered (there were 33 LGB

participants for face-to-face interviews, 86 for telephone interviews and 115 for web questionnaires).

Results from the logistic regression analyses are shown in Table 2, minimally adjusted for age and sex and then after further adjustments for ethnic minority status, parental educational attainment and occupational social class (parental SES). Sample weights were used in the models to correct for over-sampling of ethnic minority groups and socio-economically deprived schools at recruitment.

Lesbian or gay participants were more than twice as likely to have a history of cigarette smoking, and bisexual participants nearly twice as likely to have smoked, compared to heterosexual participants. Adjustment for ethnic minority status and parental SES did not change these results materially. Similar results were found when combining participants into LGB vs. heterosexual.

Participants who identified themselves as lesbian or gay were nearly twice as likely to drink alcohol more than twice a week, even after adjustment for several covariates, compared to heterosexuals. There was no association between bisexual identity and drinking alcohol more than twice a week. When combining LGB participants together, the association was weaker but remained significant, in both minimally and fully adjusted models.

Lesbian or gay participants were around 1.8 times more likely to report risky single occasion drinking more than weekly, compared to heterosexuals. This association was only slightly weaker in the fully adjusted model. There was no association between bisexual identity and RSOD. The combined LGB category was associated with this measure only in the minimally adjusted model.

In supplementary analyses separating males and females, the pattern of results for smoking history was very similar for both genders (Table S1), although it was weaker for bisexual males. For alcohol drinking greater than twice per week however, the association was stronger in males than in females. The size of the association was similar for gay men and lesbian women, although confidence intervals were wider for lesbian women. No association was apparent for bisexual men,

although there was a non-significant trend toward increased risk for bisexual women. For risky single occasion drinking, the association was stronger and significant in males but a weaker non-significant trend was suggested for females. Bisexual males appeared to be at decreased risk of risky single occasion drinking compared to heterosexuals, but this was not significant. These supplementary results should be interpreted with caution, given the small numbers of participants involved. The study may be underpowered to examine how sex modifies the association between sexual orientation and health behaviours.

Discussion

In a community-dwelling sample of over 7600 young adults in England, men and women reporting a gay/lesbian or bisexual (LGB) identity were around twice as likely to have a history of cigarette smoking than those reporting a heterosexual identity at age 18/19. LG participants were nearly twice as likely to report drinking alcohol more than twice per week, and more likely to report risky single occasion drinking more often than weekly. Bisexual participants were no more likely to report risky single occasion drinking than heterosexuals.

Strengths of the study include the large sample which was representative of an entire school year in England at recruitment, typically from the birth years 1990/91. Data from the UK on sexual orientation identity are exceptionally rare, particularly for young cohorts.^{6 22} Adjusting for the sample design, 3.5% of this cohort identified as LGB at age 18/19. The refusal rate for the sexual orientation identity question was low, particularly in the web survey, and differences in how this question was administered were not found to influence results materially. Several major cohort studies in the US have included questions on sexual orientation identity in recent years.^{10 18} In the UK however, data on health inequalities in LGB identified adults has historically come from cross-sectional surveys recruited using snowball sampling,²³ gay pride events and internet surveys¹⁹ which do not address issues of representativeness fully, even when a heterosexual control group is available. Recruitment from recreational spaces, particularly before the smoking ban, may have

introduced bias into earlier studies. The long-demonstrated association between LGB orientation and smoking¹¹⁻¹³ appears to have persisted, even in this young cohort.

A clear limitation of our study was that smoking status was last assessed in 2006 (age 15/16), two years before sexual orientation was last recorded. Participants may have changed their sexual orientation identity²⁷ or smoking status between 2006 and 2009, and so the data cannot establish an association between LGB identity and current smoking. Smoking is not known to influence sexual orientation identity, making reverse causation unlikely. It is worth noting however, that young people who begin smoking tend to continue into adulthood³⁰ and two-thirds of smokers begin before age 18,⁷ suggesting that many participants with a smoking history will have continued to smoke. A second limitation is that statistical power may not have been available to detect smaller associations, owing to the relatively small proportion of participants in sexual minority groups, particularly for supplementary analyses of men and women separately. Larger sample sizes would allow more detailed comparisons to be made, such as LG vs. bisexual participants. A third limitation was that aspects of sexual orientation other than identity (e.g. attraction, behaviour) were not available. Finally, the percentage of participants identifying as LGB may have been underestimated, particularly if this had not been disclosed to parents, who might have been in the home during telephone and home interviews. Although the refusal rate for the question was low, some participants who identify as LGB might have responded 'heterosexual' for this and other reasons, which might include socially desirable responding. This would lead to misclassification bias, leading us to have under-estimated the size of any associations found. Results were similar when additionally controlling for mode of survey administration (home visit, telephone, web survey), mitigating concerns that the results are driven by the method of data collection. Results do not generalise to young people who adopt an LGB identity after age 18/19.

Although our finding that LGB orientation is associated with smoking history is largely consistent with other studies,¹¹⁻¹³ the results concerning drinking alcohol to intoxication differ from prior reports. In several US studies, the association between LGB identity and hazardous alcohol use tends to be stronger among LB women^{16 17 24} and in a systematic review, LB identity in women was associated with alcohol dependence and heavy alcohol consumption (>14 units/week) but not GB identity in men.¹⁷ It is important to emphasize however that our study measured alcohol drinking frequency and frequency of drinking to intoxication, not dependence or misuse. Studies from the US involving younger cohorts have found similar associations to our own, between LGB identity and alcohol use.^{20 27 31-33} The extent to which gender modifies this association is not known however, and larger samples of LGB people will be needed for more detailed analyses.²⁴³⁴

Our results show that LG (but not bisexual) identity among English young people, is associated with more frequent and riskier single occasion drinking. Environmental differences between the UK and US could influence the behaviours of adults who identify as LGB. Such influences might include the age of consent, legal drinking age, laws concerning discrimination, availability of social support and recreational spaces for socializing. A study of students with same-sex sexual experiences found that greater LGB resources were associated with less smoking in women but increased risk of binge drinking in men.³⁵ Future international comparisons are necessary, and a pooled meta-analysis of individual participant data (MIPD) would be very valuable.

It is important to identify the underlying mechanisms that connect LGB identity to health behaviours. There is apparently no evidence for genetic covariance between sexual orientation identity and health behaviours, and we suggest that sexual orientation itself is unlikely to cause smoking and alcohol use. Several possible mechanisms have been proposed, which require further investigation. The concept of ‘minority stress’ is often invoked to explain how heterosexism and homophobia are internalised,²² perhaps leading people to self-medicate psychological distress with cigarettes or alcohol. A recent review found support for this theory, particularly in explaining associations with victimisation and substance use.³⁶ Alternatively, LGB young people may socialize

1
2 or have socialized in recreational spaces where cigarettes and alcohol are easily available, where
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4 peer norms encourage engagement in these behaviours,²⁷ or to appear older than their actual age.
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6 Concern with appearance could motivate smoking as a weight management strategy. Smoking may
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8 be sexually arousing for some individuals and subcultures, particularly when seen to signify
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10 masculinity.³⁷ Other commentators have noted the role of the tobacco industry in targeting LGB
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12 smokers.³⁸ Early unhealthy behaviours among LGB young people may increase risk of chronic
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14 disease in later life.^{39 40} Longitudinal repeated measures data will be necessary in order to identify
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16 the antecedents and consequences of unhealthy behaviours for LGB young people in the UK, across
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18 the life course. In our view, there is a clear need for a large prospective cohort study of LGB people
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20 in the UK, with repeated measures of health behaviours and health outcomes. This may require a
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22 heterosexual control group.
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28 Despite recent equality and diversity legislation and the inclusion of sexual orientation in the
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30 National Health Service (NHS) Equality Delivery System, sexual orientation identity is rarely
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32 monitored by NHS organisations or measured in epidemiological studies. To improve the evidence
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34 base, support international comparisons, and allocate public resources appropriately, data about
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36 sexual orientation should be collected routinely.¹² Questions about sexual orientation can be
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38 adopted at low cost and have relatively low refusal rates, particularly among young people. Wider
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40 measurement of sexual orientation will ultimately help reduce health inequalities.
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Author contributions

Isla Fitchie conducted the literature review. Gareth Hagger-Johnson conducted the statistical analyses. All authors contributed to writing the manuscript.

Data sharing statement

Data are available from the UK Data Archive.

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References

1. Dilley JA, Simmons KW, Boysun MJ, Pizacani BA, Stark MJ. Demonstrating the importance and feasibility of including sexual orientation in public health surveys: health disparities in the Pacific Northwest. *American Journal of Public Health* 2010;100(3):460-67.
2. McCabe SE, Hughes TL, Bostwick W, Morales M, Boyd CJ. Measurement of sexual identity in surveys: implications for substance abuse research. *Archives of Sexual Behavior* 2012;41(3):649-57.
3. Office of National Statistics. Measuring Sexual Identity: An Evaluation Report. London, 2010.
4. Johnson AM, Mercer CH, Erens B, Copas AJ, McManus S, Wellings K, et al. Sexual behaviour in Britain: partnerships, practices, and HIV risk behaviours. *The Lancet* 2001;358(9296):1835-42.
5. McCabe SE, Hughes TL, Bostwick WB, West BT, Boyd CJ. Sexual orientation, substance use behaviors and substance dependence in the United States. *Addiction* 2009;104(8):1333-45.
6. Mercer CH, Bailey JV, Johnson AM, Erens B, Wellings K, Fenton KA, et al. Women who report having sex with women: British national probability data on prevalence, sexual behaviors, and health outcomes. *Am J Public Health* 2007;97(6):1126-33.
7. Health and Social Care Information Centre. Statistics on smoking: England 2010. London: National Health Service, 2011.
8. Austin SB, Ziyadeh N, Fisher LB, Kahn JA, Colditz GA, Frazier AL. Sexual orientation and tobacco use in a cohort study of US adolescent girls and boys. *Arch Pediatr Adolesc Med* 2004;158(4):317-22.
9. Tang H, Greenwood GL, Cowling DW, Lloyd JC, Roeseler AG, Bal DG. Cigarette smoking among lesbians, gays, and bisexuals: how serious a problem? *Cancer Causes Control* 2004;15(8):797-803.
10. Corliss H, Wadler B, Jun H-J, Rosario M, Wypij D, Frazier L, et al. Sexual-orientation disparities in cigarette smoking in a longitudinal cohort study of adolescents. *Nicotine & tobacco research* 2013;15(1):213-22.
11. Lee JGL, Griffin GK, Melvin CL. Tobacco use among sexual minorities in the USA, 1987 to May 2007: a systematic review. *Tobacco Control* 2009;18(4):275-82.
12. Ryan H, Wortley PM, Easton A, Pederson L, Greenwood G. Smoking among lesbians, gays, and bisexuals: a review of the literature. *Am J Prev Med* 2001;21(2):142-9.
13. Blossnich J, Lee JG, Horn K. A systematic review of the aetiology of tobacco disparities for sexual minorities. *Tob Control* 2011.
14. Ortiz-Hernandez L, Tello BL, Valdes J. The association of sexual orientation with self-rated health, and cigarette and alcohol use in Mexican adolescents and youths. *Soc Sci Med* 2009;69(1):85-93.
15. King M, Nazareth I. The health of people classified as lesbian, gay and bisexual attending family practitioners in London: a controlled study. *BMC Public Health* 2006;6:127.
16. Bloomfield K, Wicki M, Wilsnack S, Hughes T, Gmel G. International Differences in Alcohol Use According to Sexual Orientation. *Substance Abuse* 2011;32(4):210-19.
17. King M, Semlyen J, Tai S, Killaspy H, Osborn D, Popelyuk D, et al. A systematic review of mental disorder, suicide, and deliberate self harm in lesbian, gay and bisexual people. *BMC Psychiatry* 2008;8(1):70.
18. Boehmer U, Miao X, Linkletter C, Clark MA. Adult health behaviors over the life course by sexual orientation. *American Journal of Public Health* 2012;102(2):292-300.
19. Keogh P, Reid D, Bourne A, Weatherburn P, Hickson F, Jessup K, et al. Wasted opportunities: Problematic alcohol and drug use among gay men and bisexual men. London: Sigma Research, 2009.
20. Corliss HL, Rosario M, Wypij D, Fisher LB, Austin SB. Sexual orientation disparities in longitudinal alcohol use patterns among adolescents findings from the Growing Up Today Study. *Archives of Pediatrics & Adolescent Medicine* 2008;162(11):1071-78.

21. Case P, Austin SB, Hunter DJ, Manson JE, Malspeis S, Willett WC, et al. Sexual orientation, health risk factors, and physical functioning in the Nurses' Health Study II. *Journal of Womens Health* 2004;13(9):1033-47.

22. Chakraborty A, McManus S, Brugha TS, Bebbington P, King M. Mental health of the non-heterosexual population of England. *British Journal of Psychiatry* 2011;198(2):143-48.

23. King M, McKeown E, Warner J, Ramsay A, Johnson K, Cort C, et al. Mental health and quality of life of gay men and lesbians in England and Wales - Controlled, cross-sectional study. *British Journal of Psychiatry* 2003;183:552-58.

24. Ziyadeh NJ, Prokop LA, Fisher LB, Rosario M, Field AE, Camargo CA, Jr., et al. Sexual orientation, gender, and alcohol use in a cohort study of US adolescent girls and boys. *Drug and Alcohol Dependence* 2007;87(2-3):119-30.

25. Tucker JS, Ellickson PL, Klein DJ. Understanding differences in substance use among bisexual and heterosexual young women. *Womens Health Issues* 2008;18(5):387-98.

26. Marshal MP, Friedman MS, Stall R, King KM, Miles J, Gold MA, et al. Sexual orientation and adolescent substance use: a meta-analysis and methodological review. *Addiction* 2008;103(4):546-56.

27. Talley AE, Sher KJ, Littlefield AK. Sexual orientation and substance use trajectories in emerging adulthood. *Addiction* 2010;105(7):1235-45.

28. Lindley LL, Walsemann KM, Carter JW, Jr. The association of sexual orientation measures with young adults' health-related outcomes. *Am J Public Health* 2012;102(6):1177-85.

29. Economic and Social Data Service. Longitudinal Study of Young People in England: Waves One to Seven. In: ESDS, editor. Colchester, 2011.

30. Gervais A, O'Loughlin J, Meshefedjian G, Bancej C, Tremblay M. Milestones in the natural course of onset of cigarette use among adolescents. *Canadian Medical Association Journal* 2006;175(3):255-61.

31. Brewster KL, Tillman KH. Sexual Orientation and Substance Use Among Adolescents and Young Adults. *American Journal of Public Health* 2012;102(6):1168-76.

32. Hatzenbuehler ML, Corbin WR, Fromme K. Trajectories and determinants of alcohol use among LGB young adults and their heterosexual peers: Results from a prospective study. *Developmental Psychology*. 2008;44(1):81-90.

33. Caldwell LL, Kivel BD, Smith EA, Hayes D. The leisure context of adolescents who are lesbian, gay male, bisexual and questioning their sexual identities: An exploratory study. *Journal of Leisure Research*. 1998;30(3):341-55.

34. Udry JR, Chantala K. Risk assessment of adolescents with same-sex relationships. *Journal of Adolescent Health* 2002;31(1):84-92.

35. Eisenberg ME, Wechsler H. Social influences on substance-use behaviors of gay, lesbian, and bisexual college students: findings from a national study. *Soc Sci Med* 2003;57(10):1913-23.

36. Collier KL, van Beusekom G, Bos HMW, Sandfort TGM. Sexual Orientation and Gender Identity/Expression Related Peer Victimization in Adolescence: A Systematic Review of Associated Psychosocial and Health Outcomes. *Journal of Sex Research*. 2013;50(3-4):299-317.

37. Aronsson H, Lind J, Ghirlanda S, Enquist M. Parental influences on sexual preferences: The case of attraction to smoking. *Journal of Evolutionary Psychology* 2011;9(1):21-41.

38. Smith EA, Malone RE. The outing of Philip Morris: advertising tobacco to gay men. *Am J Public Health* 2003;93(6):988-93.

39. Needham BL. Sexual attraction and trajectories of mental health and substance use during the transition from adolescence to adulthood. *J Youth Adolesc* 2012;41(2):179-90.

40. Marshal MP, Friedman MS, Stall R, Thompson AL. Individual trajectories of substance use in lesbian, gay and bisexual youth and heterosexual youth. *Addiction* 2009;104(6):974-81.

Table 1. Descriptive statistics for study variables (unweighted), according to sexual orientation identity in 2009, N(%)

Study variables (N = 7698) ^a	Lesbian or gay (n = 88, 1.1%)	Bisexual (n = 146, 1.9%)	Heterosexual (n = 7464, 97.0%)	p ^c	p ^d	p ^e
Female	33 (37.5)	111 (76.0)	3792 (50.8)	0.001	0.014	<0.001
Ethnic minority ^f	12 (13.6)	12 (8.2)	2112 (28.3)	<0.001	0.003	<0.001
Parental education (less than secondary)	13 (14.8)	26 (17.8)	1715 (23.0)	0.02	0.07	0.14
Parental occupation (routine or unemployed)	10 (11.4)	18 (12.3)	900 (12.1)	0.97	0.84	0.92
History of cigarette smoking (age 15/16)	35 (39.8)	60 (41.1)	1649 (22.1)	<0.001	<0.001	<0.001
Alcohol drinking >2 days/week (age 18/19)	33 (37.5)	38 (26.0)	1467 (19.7)	<0.001	<0.001	0.057
Risky single occasion drinking (age 18/19)	40 (45.5)	48 (32.9)	1985 (26.6)	<0.001	<0.001	0.090

^aAnalytic sample (N = 7698) comprises participants with available data on age, sex, ethnic group, parental education, occupational social class, smoking history and alcohol use. ^cp value for lesbian/gay/bisexual vs. heterosexual, ^dp value for gay/lesbian vs. heterosexual, ^ep bisexual vs. heterosexual. ^fUnweighted frequency (ethnic minority groups were over-sampled).

Table 2. Association between sexual orientation identity and smoking, alcohol drinking >2 days/week and risky single occasion drinking

N=7698	History of cigarette smoking vs. non-smoker		Alcohol drinking >2 days/week vs. <=2 days/week or never		>Weekly risky single occasion drinking vs. <=weekly	
	Minimally adjusted ^b	Fully adjusted ^c	Minimally adjusted ^b	Fully adjusted ^c	Minimally adjusted ^b	Fully adjusted ^c
<i>Model 1</i>						
Lesbian or gay (vs. heterosexual)	2.34*** (1.50, 3.65)	2.23** (1.42, 3.51)	1.99*** (1.28, 3.09)	1.99** (1.25, 3.17)	1.82*** (1.16, 2.84)	1.80* (1.13, 2.86)
Bisexual (vs. heterosexual)	1.94*** (1.37, 2.75)	1.84** (1.30, 2.61)	1.26 (0.84, 1.89)	1.20 (0.79, 1.81)	1.11 (0.76, 1.61)	1.04 (0.71, 2.86)
<i>Model 2</i>						
Lesbian, gay or bisexual (vs. heterosexual)	2.08*** (1.57, 2.76)	1.98*** (1.49, 2.63)	1.53*** (1.15, 2.03)	1.48* (1.10, 1.99)	1.35* (1.01, 1.79)	1.29 (0.96, 1.74)

Values shown are odds ratios (95% confidence intervals). *** = p < 0.001, ** = p < 0.01, * = p < 0.05. ^aAnalytic sample (comprises participants with available data on age, sex, ethnic group, parental education and occupational social class, smoking and alcohol use. Sample weights are applied. ^bAdjusted for age and sex. ^cAdjusted for age, sex, ethnic minority status, parental educational attainment, parental occupational social class.

Table S1. Association between sexual orientation identity and smoking, alcohol drinking >2 days/week and risky single occasion drinking

	History of cigarette smoking vs. non-smoker		Alcohol drinking >2 days/week vs. <=2 days/week or never		>Weekly risky single occasion drinking vs. <=weekly	
	Minimally adjusted ^b	Fully adjusted ^c	Minimally adjusted ^b	Fully adjusted ^c	Minimally adjusted ^b	Fully adjusted ^c
<i>Males (n = 3762)</i>						
Gay (vs. heterosexual)	2.38** (1.31, 4.33)	2.31** (1.27, 4.20)	1.92* (1.10, 3.35)	1.95* (1.07, 3.55)	2.13* (1.21, 3.77)	2.15* (1.19, 3.87)
Bisexual (vs. heterosexual)	1.93 (0.92, 4.09)	1.88 (0.88, 4.00)	1.04 (0.49, 2.20)	0.95 (0.44, 2.07)	0.67 (0.30, 1.46)	0.61 (0.27, 1.36)
<i>Females (n = 3936)</i>						
Gay (vs. heterosexual)	2.30* (1.14, 4.62)	2.14* (1.04, 4.38)	2.10 (1.00, 4.42)	2.06 (0.84, 2.15)	1.40 (0.68, 2.88)	1.34 (0.63, 2.86)
Bisexual (vs. heterosexual)	1.93** (1.30, 2.87)	1.82* (1.23, 2.69)	1.39 (0.87, 2.21)	1.35 (0.84, 2.15)	1.32 (0.87, 2.00)	1.26 (0.82, 1.94)

Values shown are odds ratios (95% confidence intervals). *** = $p < 0.001$, ** = $p < 0.01$, * = $p < 0.05$. ^aAnalytic sample (comprises participants with available data on age, sex, ethnic group, parental education and occupational social class, smoking and alcohol use. Sample weights are applied.

^bAdjusted for age. ^cAdjusted for age, ethnic minority status, parental educational attainment, parental occupational social class.

Sexual orientation identity in relation to smoking history and alcohol use at age 18/19: Cross-sectional associations from ~~wave 6 of~~ the Longitudinal Study of Young People in England (LSYPE)

Running head: Sexual orientation, smoking, alcohol use.

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Abstract

Objectives. Information about the health behaviours of minority groups is essential for addressing health inequalities. We evaluated the association between lesbian, gay or bisexual (LGB) sexual orientation identity and smoking and alcohol use in young people in England.

Design. Data drawn from wave 6 of the Longitudinal Study of Young People in England (LSYPE).

Setting. Self-completion questionnaires during home visits, face-to-face interviews, and web-based questionnaires.

Participants. Data from 7698 participants (3762 men) with information on sexual orientation identity and health behaviours at age 18/19.

Outcome measures. Cigarette smoking history, alcohol drinking frequency, and risky single occasion drinking (RSOD).

Results. LGB identity was reported by 3.1% of participants (55 gay, 33 lesbian, 35 bisexual male, 111 bisexual female), 3.5% when adjusting for the survey design. Adjusting for a range of covariates, identification as lesbian/gay was found to be associated with smoking (OR = 2.2823, 95% CI 1.4642, 3.5851), alcohol drinking >2 days/week (OR = 1.9699, 95% CI 1.2425, 3.4417), and RSOD (OR = 1.7680, 95% CI 1.4413, 2.7986) more than weekly. Bisexual identity was associated with smoking history (OR = 1.8784, 95% CI 1.3230, 2.64) and RSOD (OR = 1.02, 95% CI 1.02, 2.79), 61) but not alcohol drinking >2 days/week (OR = 1.4720, 95% CI 0.79, 1.81) or RSOD (OR = 1.04, 95% CI 0.78, 1.7771, 2.86).

Conclusions. In a sample of over 7600 young people age 18/19 in England, lesbian/gay identity is associated with cigarette smoking, drinking alcohol frequency and RSOD. Bisexual identity is associated with smoking and RSOD, but not RSOD or frequent alcohol drinking frequency.

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Key words: Alcohol Drinking, Alcoholic Intoxication, Cigarette Smoking, Cohort Studies,
Sexuality.

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Article summary

Article focus

- Studies, mainly from the US, have found an association between lesbian, gay or bisexual (LGB) sexual orientation and cigarette smoking
- Previous results for alcohol use are mixed, therefore the association should be ~~tested~~evaluated

Key messages

- LGB orientation identity is associated with higher rates of smoking history in a population sample of English 18/19 year-olds, compared to heterosexual or 'straight' identity
- Lesbian or gay ~~orientation~~(compared to heterosexual) identity is associated with increased risk of drinking alcohol more than twice per week and risky single occasion drinking
- Bisexual ~~orientation~~(compared to heterosexual) identity is associated with smoking but not alcohol drinking frequently or risky single occasion drinking ~~but not alcohol drinking frequency~~
- Recording sexual orientation is necessary for describing health inequalities and among young people, there is a very low refusal rate (0.1%)

Strengths and limitations of this study

- This cohort is among the first in the UK to record sexual orientation identity
- Smoking history was available but not current smoking status ~~was recorded~~ at age 18/19
- ~~Frequency but not~~ Data on the quantity of alcohol ~~consumption~~typically consumed was not available

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- Numbers of LGB participants were small, which could be addressed by a large prospective cohort study of LGB people

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Introduction

Knowledge about the health behaviours of sexual minority groups is necessary for monitoring health inequalities, developing public health policies, allocating resources and targeting high risk

groups for interventions.^{1-3, 2} It is estimated that between 1.5%⁴³ and around 5%⁵⁴ of the UK population are lesbian, gay, or bisexual (LGB). Estimates ~~tend to be larger when attraction or can~~ vary depending on whether identity, sexual behaviour or same-sex attraction are used to define sexual orientation.^{3, 5, 6-8} Additionally, estimates ~~are found to~~ can vary by age and ethnic group.^{4, 3}

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Relatively few research studies include a measure of sexual orientation identity, particularly in the UK. As a result, the evidence base on health inequalities ~~for experienced by~~ LGB groups ~~people~~ is very sparse. Exceptions include the National Attitudes of Sexual Attitudes and Lifestyles (NATSAL; 1990-91, 1999-01, 2010-12), National Statistics Opinions Survey (in 2008-09), ONS Integrated Household Survey⁴ ~~and (from 2009)~~, the Longitudinal Study of Young People in England⁹ ~~which both included the question for the first time in 2009, (from 2009), Health Survey for England (from 2010)~~ and the Scottish Household Health Survey (from ~~2011-2008~~).

Cigarette smoking is a prevalent behaviour among young people.^{40, 7} Many studies have shown an association between LGB orientation and cigarette smoking^{11-13, 15, 19, 25, 26, 11}; particularly,⁸⁻¹³ mostly in the US^{3, 12, 21} ~~but also in different countries~~²²⁻²⁴; Mexico¹⁴ and the UK.¹⁵ The association is usually found in men and women and in different age groups, ~~with some exceptions~~²³⁻²⁵⁻²⁸; ~~but~~ particularly in young LGB ~~people~~¹¹⁻²⁹; people.^{8, 14} Occasionally the association is found to be stronger in women^{23-25-27, 15}. Some studies ~~have~~ used sexual orientation identity as a measure of sexual orientation.¹¹⁻¹³ ~~25-26~~, some used same-sex attraction^{18, 27} and some used multiple measures.^{3-30, 11}

Alcohol use is also common among young people, but evidence supporting an association between LGB identity and alcohol use is ~~mixed~~^{3-26, 31-32} mixed,¹⁶ with evidence for possible effect modification by ~~sex~~^{3-26, 32} sex. A systematic review found increased risk of alcohol dependence in men and women and an association between LB identity and alcohol misuse in women only.^{3, 17} A

pooled analysis of data from 14 countries found greater alcohol intake and more risky single occasion drinking (RSOD) in lesbian women but not gay ~~men~~³³ men, compared to heterosexuals.¹⁶ Studies reporting an association between gay/bisexual male (hereafter, GB men) identity and heavier alcohol use are fewer ~~with one finding~~. One study found an association specific in relation to ~~those~~GB men under 50.^{20, 18} There is evidence of a higher prevalence of heavy and potentially hazardous alcohol use among GB men recruited from recreational spaces, gay pride events and web surveys.^{33-34, 19}

Several studies have found an association among lesbian/bisexual women (hereafter, LB women) compared to heterosexual women for greater alcohol intake^{27-28, 35-37, 6, 20, 21} alcohol dependence^{37, 38, 17, 22} and risky single occasion drinking.^{15, 23, 37, 39-42} One study found elevated risk of alcohol use among lesbian/bisexual females and ‘mostly heterosexual’ males, but not gay ~~males~~⁴² males.²⁴ Similar patterns have been found among adolescents in the transition to early ~~adulthood~~^{29, 42} adulthood,²⁴⁻²⁶ among University students^{40, 27} in midlife³⁵, across the adult age range^{15, 18, 23, 38, 39} ~~when using behavioural definitions of sexual orientation~~⁴¹ orientation⁶ and in different countries including ~~Mexico~~²² Mexico¹⁴ and the UK.^{6, 15, 23, 24, 27, 39, 28}

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The aim of our study was to estimate the association between LGB orientation identity and cigarette smoking history, frequency of drinking alcohol more than twice per week and ~~risky single occasion drinking~~RSOD, in young people (age 18/19) in England.

Methods

The Longitudinal Study of Young People in England (LSYPE) is a prospective cohort study of English school pupils with repeated annual follow-ups^{9, 29}. At recruitment in 2004, participants (N = 15,770) were typically aged 13/14. The cohort was created to evaluate the transitions made by young people from secondary and tertiary education into adulthood. Pupils and parents were invited

to participate by letter, using databases of schools to identify potential participants. Schools were defined as socio-economically deprived if they fell within the lowest quintile of schools ranked according to the proportion of pupils in receipt of school meals. Socio-economically deprived schools were over-sampled by a factor 1.5 and ethnic ~~minority groups~~ minorities to achieve N=1000 per ethnic group. Annual home interview visits incorporated a computer-assisted self-completion element, including questions about smoking (most recently in 2006, typical age 15/16), alcohol consumption and sexual orientation identity (both in 2009, age 18/19). In 2009, participants were offered either a home visit (face-to-face interview and computer-assisted self-completion questionnaire), telephone interview or web questionnaire.

Sexual orientation identity. Sexual orientation identity was measured in 2009 using the question 'Which of the following best describes how you think of yourself?' for the web questionnaire (N = 2690, 40.4%), and for the home visit (N = 848, 12.7%) and telephone interview (N = 3118, 46.8%), 'I will now read out a list of terms people sometimes use to describe how they think of themselves: Heterosexual or straight; Gay or lesbian; Bisexual, Other. As I read the list again please say 'yes' when you hear the option that best describes how you think of yourself'. These response options are recommended by the Office of National Statistics-^{4,3} The refusal rate for this question was 0.1% and 0.3% reported 'Other'.

Cigarette smoking. Cigarette smoking was last measured in 2006 (typical age 15/16) with the question 'Do you ever smoke cigarettes at all?' followed by six response options (I have never smoked, I have only ever tried smoking once, I used to smoke sometimes but I never smoke a cigarette now, I sometimes smoke cigarettes now but I don't smoke as many as one a week, I usually smoke between one and six cigarettes a week, I usually smoke more than six cigarettes a week). These were grouped into smoker (sometimes or weekly smoking) versus non-smoker.

Weekly alcohol drinking. Alcohol drinking was measured in 2009 using the question 'Thinking about the last 12 months, about how often did you usually have an alcoholic drink?' with seven

response options (Almost every day, Five or six days a week, Three or four days a week, Once or twice a week, Once or twice a month, Once every couple of months, Once or twice a year).

Responses were grouped into ‘more than twice per week’ versus ‘less than twice per week’.

Risky single occasion drinking. Participants were asked, ‘On those days when you did have an alcoholic drink, how often would you say you got drunk?’ followed by six response options (Every time, Most times, Around half the time, Less than half the time, Rarely, Never). This information was combined with alcohol drinking frequency to identify participants who reported drunkenness more than 52 times per year, equivalent to drinking alcohol to intoxication more than once per week.

Demographic covariates. Age and sex were recorded at baseline in 2004. Pupils self-reported their ethnic group and responses were grouped into five categories: White, Mixed, Indian/Pakistani/Bangladeshi, Black Caribbean/Black African, Chinese; grouped into ‘ethnic minority’ (1) or White (0). The maximum of either parent’s educational attainment was recorded on a six-point scale ranging from ‘no qualification’ (0) to ‘degree or equivalent’ (6). Occupational social class was recorded on an eight-point scale ranging from ‘never worked or long term unemployed’ (1) to ‘higher managerial and professional occupations’ (8), for one or both parents. Parental education attainment and occupational class are both considered indicators of parental socio-economic status (SES).

Statistical analysis. For descriptive analyses, chi-square tests were used to identify significant differences for gay/bisexual vs. heterosexual participants for each study variable. Logistic regression was used to identify whether the mode of survey administration (home visit, telephone interview or web questionnaire) influenced reporting of LGB identity. For the main analysis, logistic regression was used to calculate odds ratios that summarized the relative risk of cigarette smoking, weekly alcohol drinking and hazardous alcohol drinking among weekly alcohol drinkers, according to sexual orientation identity (gay vs. heterosexual and bisexual vs. heterosexual). We

minimally adjusted the odds ratios for age and sex, and then additionally adjusted the estimates for ethnic minority status, parental education and social class. Ethnicity and socio-economic status are possible confounding factors, because they may be associated both with sexual identity and with health behaviours. We also combined gay/lesbian and bisexual into a single 'LGB' category for additional analysis. Sample weights were used to obtain correct standard errors, allowing for over-sampling of schools with low socio-economic status and for ethnic minority pupils at recruitment. Although statistical power for evaluating possible effect modification by gender and socio-economic status was low, previous studies have shown sex differences (particularly for alcohol use). We therefore ran separate models for males and females in supplementary analyses. In sensitivity analysis, we additionally controlled for mode of survey administration, to evaluate if this influenced the results. All analyses were performed with Stata version 12.1.

Results

The analytic sample comprised 7698 participants with data on sexual orientation identity, smoking history and alcohol use in addition to covariates (home visit = 12.2%, telephone interview = 47.6%, web questionnaire = 40.1%). Compared to the recruitment sample and adjusting for the study design, the analytic sample contained slightly fewer men (49.4% vs. 53.9%, $p < 0.001$), fewer ethnic minorities (9.9% vs. 14.9%, $p < 0.001$), fewer participants whose parents had less than secondary school level educational qualifications (17.0% vs. 29.2%, $p < 0.001$) and fewer participants with parents who were unemployed or had routine occupations (8.1% vs. 15.5%, $p < 0.001$).

Unweighted descriptive statistics for study variables are shown in Table 1. A total of 3% were classified as lesbian, gay or bisexual (55 gay men, 33 lesbian women, 34 bisexual men, 108 bisexual women, 3229 heterosexual men, 3197 heterosexual women). There were fewer women (37.5%) in the 'LG' category than men, but more women (76.0%) in the '~~B~~-bisexual' category than men. When using sample weights to correct for over-sampling of ethnic minority groups and

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schools with higher socio-economic deprivation however, the proportion of participants classified as LGB was 3.5% (1.3% LG, 2.2% ~~B~~bisexual).

Compared to the web survey, participants completing the telephone interview were more likely to report heterosexual compared to LGB identity (OR = 1.55, 95% CI 1.16, 2.06). There were no significant differences in reporting heterosexual identity between the home visit and the web survey (OR = 1.16, 95% CI 0.77, 1.73), although this test may be under-powered (there were 33 LGB participants for face-to-face interviews, 86 for telephone interviews and 115 for web questionnaires).

Results from the logistic regression analyses are shown in Table 2, minimally adjusted for age and sex and then after further adjustments for ethnic minority status, parental educational attainment and occupational social class (parental SES). Sample weights were used in the models to correct for over-sampling of ethnic minority groups and socio-economically deprived schools at recruitment.

Lesbian or gay participants were more than twice as likely to have a history of cigarette smoking, and bisexual participants nearly twice as likely to have smoked-, compared to heterosexual participants. Adjustment for ethnic minority status and parental SES did not change these results materially. Similar results were found when combining participants into LGB vs. heterosexual.

Participants who identified themselves as lesbian or gay were nearly twice as likely to drink alcohol more than twice a week, even after adjustment for several covariates-, compared to heterosexuals.

There was no association between bisexual identity and drinking alcohol more than twice a week. When combining LGB participants together, the association was weaker but remained significant, in both minimally and fully adjusted models.

Lesbian or gay participants were around 1.8 times more likely to report risky single occasion drinking more than weekly-, compared to heterosexuals. This association was only slightly weaker in the fully adjusted model. There was no association between bisexual identity and ~~greater than~~

~~weekly risky single occasion drinking-RSOD~~. The combined LGB category was associated with this measure only in the ~~fully~~minimally adjusted model.

In supplementary analyses separating males and females, the pattern of results for smoking history was very similar for both genders (Table S1), although it was weaker for bisexual males. For alcohol drinking greater than twice per week however, the association was stronger in males than in females. The size of the association was similar for gay men and lesbian women, although confidence intervals were wider for lesbian women. No association was apparent for bisexual men, although there was a non-significant trend toward increased risk for bisexual women. For risky single occasion drinking, the association was stronger and significant in males but a weaker non-significant trend was suggested for females. Bisexual males appeared to be at decreased risk of risky single occasion drinking compared to heterosexuals, but this was not significant. These supplementary results should be interpreted with caution, given the small numbers of participants involved. The study may be underpowered to examine ~~effect modification of~~how sex modifies the association between sexual orientation and health behaviours.

Discussion

In a community-dwelling sample of over 7600 young adults in England, men and women reporting a gay/lesbian or bisexual (LGB) identity were around twice as likely to have a history of cigarette smoking ~~at age 15/16~~ than those reporting a heterosexual identity at age 18/19. ~~Lesbian or gay LG~~ participants were nearly twice as likely to report drinking alcohol more than twice per week, and more likely to report risky single occasion drinking more often than weekly. Bisexual participants were no more likely to report risky single occasion drinking than heterosexuals.

Strengths of the study include the large sample which was representative of an entire school year in England at recruitment, typically from the birth years 1990/91. Data from the UK on sexual orientation identity are exceptionally rare, particularly for young cohorts-^{24,38, 6, 22}. Adjusting for the sample design, 3.5% of this cohort identified as LGB at age 18/19. The refusal rate for the sexual

orientation identity question was low, particularly in the web survey, and differences in how this question was administered were not found to influence results materially. Several major cohort studies in the US ⁴¹⁻⁴⁴ ~~have~~^{have} included questions on sexual orientation identity in recent years. ^{10 18} In the UK however, data on health inequalities in LGB identified adults has historically come from cross-sectional surveys recruited using snowball sampling-^{39 23} gay pride events and internet ~~surveys~~³⁴ ~~surveys~~¹⁹ which do not address issues of representativeness fully, even when a heterosexual control group is available-³⁹. Recruitment from recreational spaces, particularly before the smoking ban, may have introduced bias into earlier studies. The long-demonstrated association between LGB orientation and ~~smoking~~^{3 43 45 46} ~~smoking~~¹¹⁻¹³ appears to have persisted, even in this young cohort.

A clear limitation of our study was that smoking status was last assessed in 2006 (age 15/16), two years before sexual orientation was last recorded. Participants may have changed their sexual orientation ~~identity~~⁴⁰ ~~identity~~²⁷ or smoking status between 2006 and 2009, and so the data cannot establish an association ~~with~~^{between LGB identity and} current smoking. Smoking is not known to influence sexual orientation identity, making reverse causation ~~an unlikely explanation~~. It is worth noting however, that young people who begin smoking tend to continue into ~~adulthood~~⁴⁷ ~~adulthood~~³⁰ and two-thirds of smokers begin before age 18-^{10 7} ~~7~~ suggesting that many ~~of these~~ ~~reporting participants with a~~ ~~smoking history~~ ~~of smoking are still current smokers will have~~ ~~continued to smoke~~. A second limitation is that statistical power may not have been available to detect smaller associations, owing to the relatively small proportion of participants in sexual minority groups, particularly for supplementary analyses of men and women separately. ~~Larger sample sizes would allow more detailed comparisons to be made, such as LG vs. bisexual participants~~. A third limitation was that aspects of sexual orientation other than identity ~~such as~~^{(e.g.} attraction ~~and behaviours~~^{8-26 48} ~~behaviour~~) were not ~~recorded~~^{available}. Finally, the percentage of participants identifying as LGB may have been underestimated, particularly if this had not been disclosed to parents, who might have been in the home during telephone and home interviews.

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Although the refusal rate for the question was low, some participants who identify as LGB might have responded 'heterosexual' for this and other reasons, which might include socially desirable responding.⁴⁻⁴⁹ This would lead to misclassification bias, leading us to have under-estimated the size of any associations found. Results were similar when additionally controlling for mode of survey administration (home visit, telephone, web survey), mitigating concerns that the results are driven by the method of data collection. Results do not generalise to young people who adopt an LGB identity after age 18/19.

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Although our finding that LGB orientation is associated with smoking history is largely consistent with other studies,¹¹⁻¹³ the results concerning drinking alcohol to intoxication differ from prior reports. In several US studies, the association between LGB identity and hazardous alcohol use tends to be stronger among LB ~~women~~¹⁵⁻²³⁻³⁹⁻⁴¹ women^{16 17 24} and in a systematic review, LB identity in women was associated with alcohol dependence and ~~misuse; misuse defined as~~ >21/heavy alcohol consumption (>14 units/week) but not GB identity in men/~~women~~^{3, 17}. It is important to emphasize however that our study measured alcohol drinking frequency and frequency of drinking to intoxication, not dependence or misuse. Studies from the US involving younger cohorts have ~~reported associations with hazardous alcohol drinking~~⁴³ for LGB men³⁰⁻⁵⁰ ~~and women~~³⁶ found similar associations to our own, between LGB identity and alcohol use.^{20 27 31-33} The extent to which gender modifies this association is not known however, and larger samples of LGB people will be needed for more detailed analyses.²⁴³⁴

Our results show that LG (but not bisexual) identity among English young people⁴⁰ ~~Overall, the picture is mixed. Some studies find are stronger association between LG or GB identity and alcohol use in women~~⁴²⁻⁵¹ ~~, some find a stronger association in men~~³¹ ~~, and some an association for B but not L women~~⁵¹ . Our results show an association between LG identity in men and women combined, similar patterns when separating men and women, but with a stronger association in men (Table

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~~S1). L or G identity among English youth, but not B identity~~, is associated with more frequent and riskier single occasion drinking. Environmental differences between the UK and US could influence the behaviours of adults who identify as LGB. Such influences might include the age of consent, legal drinking age, laws concerning discrimination, availability of social support and recreational spaces for socializing. A study of students with same-sex sexual experiences found that greater LGB resources were associated with less smoking in women but increased risk of binge drinking in ~~men~~⁵² ~~-men~~³⁵. Future international comparisons are necessary, and a pooled meta-analysis of individual participant data (MIPD) would be very valuable.

It is important to identify the underlying mechanisms that connect LGB identity to health behaviours. There is apparently no evidence for genetic covariance between sexual orientation identity and health behaviours, and we suggest that sexual orientation itself is unlikely to cause smoking and alcohol use. Several possible mechanisms have been proposed, which require further investigation. The concept of ‘minority stress’³⁸ is often invoked to explain how heterosexism and homophobia are internalised,²² perhaps leading people to self-medicate psychological distress with cigarettes or alcohol³⁶. A recent review found support for this theory, particularly in explaining associations with victimisation and substance ~~use~~⁵³ ~~-use~~³⁶. Alternatively, LGB young people may socialize or have socialized in recreational spaces where cigarettes and alcohol are easily available, where peer norms encourage engagement in these behaviours^{40, 27} or to appear older than their actual age. Concern with appearance could motivate smoking as a weight management strategy. ~~For some, smoking can~~ Smoking may be sexually arousing for some individuals and subcultures, particularly ~~if it is associated with masculinity~~⁵⁴ ~~or where there is a sexual attraction~~ when seen to ~~men smoking~~⁵⁵ ~~-signify masculinity~~³⁷. Other commentators have noted the role of the tobacco industry in targeting LGB smokers^{54, 38}. Early unhealthy behaviours among LGB young people may ~~influence trajectories toward~~ increase risk of chronic disease in later life^{15-27, 39, 40}. Longitudinal repeated measures data will be necessary in order to identify the antecedents and consequences of unhealthy behaviours for LGB young people in the UK, across the life course. In our view, there is

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a clear need for a ~~repeated measures large prospective~~ cohort study of LGB people in the UK, with repeated measures of health behaviours and health outcomes. This may require a heterosexual control group.

Despite recent equality and diversity legislation and the inclusion of sexual orientation in the National Health Service (NHS) Equality Delivery System, sexual orientation identity is rarely monitored by NHS organisations or measured in epidemiological studies. To improve the evidence base, ~~and~~ support international comparisons, and allocate public resources appropriately, data about sexual orientation should be collected routinely.¹⁻³ ~~In the Integrated Household Survey for example, it will now be possible to consider sexual orientation identity in relation to health status, smoking and subjective wellbeing, among other topics.~~² Questions about sexual orientation can be ~~added~~ adopted at low cost and have relatively low refusal rates, particularly among young people. Wider measurement of sexual orientation ~~would~~ will ultimately help reduce health inequalities.

Author contributions

Isla Fitchie conducted the literature review. Gareth Hagger-Johnson ~~did~~conducted the statistical analyses. All authors contributed to writing the manuscript.

Data sharing statement

Data are available from the UK Data Archive.

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References

1. McCabe SE, Hughes TL, Bostwick W, *et al*. ~~Measurement of sexual identity in surveys: implications for substance abuse research.~~ *Arch Sex Behav* 2012;41:649-57.

2. Dilley JA, Simmons KW, Boysun MJ, ~~et al~~ Pizacani BA, Stark MJ. Demonstrating the importance and feasibility of including sexual orientation in public health surveys: health disparities in the Pacific Northwest. *Am J American Journal of Public Health* 2010;100(3):460-67.

3. Lee JGL, Griffin GK, Melvin CL. Tobacco use among sexual minorities in the USA, 1987 to May 2007: a systematic review. 2. McCabe SE, Hughes TL, Bostwick W, Morales M, Boyd CJ. Measurement of sexual identity in surveys: implications for substance abuse research. *Tob Control* 2009;18:275-82.

4. *Archives of Sexual Behavior* 2012;41(3):649-57.

3. Office for National Statistics. Measuring Sexual Identity: An Evaluation Report. 2010. <http://www.ons.gov.uk/ons/rel/ethnicity/measuring-sexual-identity-evaluation-report/2010/index.html> (accessed 28 April 2013). London, 2010.

54. Johnson AM, Mercer CH, Erens B, Copas AJ, McManus S, Wellings K, *et al*. Sexual behaviour in Britain: partnerships, practices, and HIV risk behaviours. *The Lancet* 2001;358(9296):1835-42.

6-5. McCabe SE, Hughes TL, Bostwick WB, West BT, Boyd CJ, Hughes TL, *et al*. Dimensions of sexual orientation, substance use behaviors and the prevalence of mood and anxiety disorders substance dependence in the United States. *Am J Public Health* 2010;100:468-75.

7. Corte C, Matthews A, Kuhn L, *et al*. Dimensions of sexual identity development and alcohol and drug-related risk behavior in sexual minority men. *Alcohol Clin Exp Res* 2010;34:241A-41A.

8. McCabe SE, Hughes TL, Bostwick W, *et al*. Assessment of difference in dimensions of sexual orientation: Implications for substance use research in a college age population. *J Stud Alcohol* 2005;66(620-29):1333-45.

9. Department for Education and National Centre for Social Research, *Longitudinal Study of Young People in England: Waves One to Seven, 2004-2010* [computer file]. 12th Edition. Colechester, Essex: UK Data Archive [distributor], August 2012. SN: 5545

<http://dx.doi.org/10.5255/UKDA-SN-5545-3> (accessed 14/01/2013)

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~~10. The Health and Social Care Information Centre. *Statistics on Smoking: England, 2010*.
<http://www.hscic.gov.uk/pubs/smoking10> (accessed 28 April 2013)~~

~~11. Austin SB, Ziyadeh N, Fisher LB, *et al*. Sexual orientation and tobacco use in a cohort study of
US adolescent girls and boys. *Arch Pediatr Adolesc Med* 2004;~~158~~:317-22.~~

~~12. Tang H, Greenwood GL, Cowling DW, *et al*. Cigarette smoking among lesbians, gays, and
bisexuals: how serious a problem? *Cancer Causes Control* 2004;~~15~~:797-803.~~

~~13. Gruskin EP, Gordon N. Gay/Lesbian sexual orientation increases risk for cigarette smoking and
heavy drinking among members of a large Northern California health plan. *BMC Public
Health* 2006;~~6~~:241.~~

~~14. Gruskin EP, Greenwood GL, Matevia M, *et al*. Disparities in smoking between the lesbian, gay,
and bisexual population and the general population in California. *Am J Public Health*
2007;~~97~~:1496-502.~~

~~15. Marshal MP, Friedman MS, Stall R, *et al*. Individual trajectories of substance use in lesbian,
gay and bisexual youth and heterosexual youth. *Addiction* 2009;~~104~~:974-81.~~

~~16. Hatzenbuehler ML, Wieringa NF, Keyes KM. Community level determinants of tobacco use
disparities in lesbian, gay, and bisexual youth: results from a population-based study. *Arch
Pediatr Adolesc Med* 2011;~~165~~:527-32.~~

~~17. Pizacani BA, Rohde K, Bushore C, *et al*. Smoking-related knowledge, attitudes and behaviors
in the lesbian, gay and bisexual community: a population-based study from the U.S. Pacific
Northwest. *Prev Med* 2009;~~48~~:555-61.~~

~~18. Easton A, Jackson K, Mowery P, *et al*. Adolescent same-sex and both-sex romantic attractions
and relationships: implications for smoking. *Am J Public Health* 2008;~~98~~(3):462-7.~~

~~19. Corliss H, Wadler B, Jun H-J, *et al*. Sexual orientation disparities in cigarette smoking in a
longitudinal cohort study of adolescents. *Nicotine Tob Res* 2013;~~15~~:213-22.~~

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20. McKirnan DJ, Tolou Shams M, Turner L, *et al*. Elevated risk for tobacco use among men who have sex with men is mediated by demographic and psychosocial variables. *Subst Use Misuse* 2006;41:1197-208.

21. Austin EL, Irwin JA. Age differences in the correlates of problematic alcohol use among southern lesbians. *J Stud Alcohol Drugs* 2010;71:295-8.

22. Ortiz-Hernandez L, Tello BL, Valdes J. The association of sexual orientation with self-rated health, and cigarette and alcohol use in Mexican adolescents and youths. *Soc Sci Med* 2009;69:85-93.

23. King M, Nazareth I. The health of people classified as lesbian, gay and bisexual attending family practitioners in London: a controlled study. *BMC Public Health* 2006;6:127.

24-6. Mercer CH, Bailey JV, Johnson AM, Erens B, Wellings K, Fenton KA, *et al*. Women who report having sex with women: British national probability data on prevalence, sexual behaviors, and health outcomes. *Am J Public Health* 2007;97(6):1126-33.

7. Health and Social Care Information Centre. *Statistics on smoking: England 2010*. London: National Health Service, 2011.

8. Austin SB, Ziyadeh N, Fisher LB, Kahn JA, Colditz GA, Frazier AL. Sexual orientation and tobacco use in a cohort study of US adolescent girls and boys. *Arch Pediatr Adolesc Med* 2004;158(4):317-22.

9. Tang H, Greenwood GL, Cowling DW, Lloyd JC, Roeseler AG, Bal DG. Cigarette smoking among lesbians, gays, and bisexuals: how serious a problem? *Cancer Causes Control* 2004;15(8):797-803.

10. Corliss H, Wadler B, Jun H-J, Rosario M, Wypij D, Frazier L, *et al*. Sexual-orientation disparities in cigarette smoking in a longitudinal cohort study of adolescents. *Nicotine & tobacco research* 2013;15(1):213-22.

11. Lee JGL, Griffin GK, Melvin CL. Tobacco use among sexual minorities in the USA, 1987 to May 2007: a systematic review. *Tobacco Control* 2009;18(4):275-82.

12. Ryan H, Wortley PM, Easton A, Pederson L, Greenwood G. Smoking among lesbians, gays, and bisexuals: a review of the literature. *Am J Prev Med* 2001;21(2):142-9.

13. Blosnich J, Lee JG, Horn K. A systematic review of the aetiology of tobacco disparities for sexual minorities. *Tob Control* 2011.

14. Ortiz-Hernandez L, Tello BL, Valdes J. The association of sexual orientation with self-rated health, and cigarette and alcohol use in Mexican adolescents and youths. *Soc Sci Med* 2009;69(1):85-93.

15. King M, Nazareth I. The health of people classified as lesbian, gay and bisexual attending family practitioners in London: a controlled study. *BMC Public Health* 2006;6:127.

25. Trocki KF, Drabble LA, Midanik LT. Tobacco, marijuana, and sensation seeking: comparisons across gay, lesbian, bisexual, and heterosexual groups. *Psychol Addict Behav* 2009;23:620-31.

26. Lindley LL, Walsemann KM, Carter JW, Jr. The association of sexual orientation measures with young adults' health related outcomes. *Am J Public Health* 2012;102:1177-85.

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~~27. Needham BL. Sexual attraction and trajectories of mental health and substance use during the transition from adolescence to adulthood. *J Youth Adoles* 2012;**41**:179-90.~~

~~28. Needham BL, Austin EL. Sexual orientation, parental support, and health during the transition to young adulthood. *J Youth Adoles* 2010;**39**:1189-98.~~

~~29. Tucker JS, Ellickson PL, Klein DJ. Understanding differences in substance use among bisexual and heterosexual young women. *Womens Health Issues* 2008;**18**:387-98.~~

~~30. Brewster KL, Tillman KH. Sexual Orientation and Substance Use Among Adolescents and Young Adults. *Am J Public Health* 2012;**102**:1168-76.~~

~~31. Caldwell LL, Kivel BD, Smith EA, et al. The leisure context of adolescents who are lesbian, gay male, bisexual and questioning their sexual identities: An exploratory study. *J Leis Res* 1998;**30**:341-55.~~

~~32~~16. Bloomfield K, Wicki M, Wilsnack S, ~~et al.~~ Hughes T, Gmel G. International Differences in Alcohol Use According to Sexual Orientation. ~~*Subst Abuse*~~ *Substance Abuse* 2011;**32**(4):210-19.

~~33. Keogh P, Reid D, Bourne A, et al. Wasted opportunities: Problematic alcohol and drug use among gay men and bisexual men. London: Sigma Research, 2009.~~

~~34. Hickson, F. Consuming passions: Findings from the United Kingdom gay men's sex survey 2005. Sigma Research, 2007.~~

~~35. Case P, Austin SB, Hunter DJ, et al. Sexual orientation, health risk factors, and physical functioning in the Nurses' Health Study II. *J Womens Health* 2004;**13**:1033-47.~~

~~36. Corliss HL, Rosario M, Wypij D, et al. Sexual orientation disparities in longitudinal alcohol use patterns among adolescents findings from the Growing Up Today Study. *Arch Pediatr Adolesc Med* 2008;**162**:1071-78.~~

~~37~~17. King M, Semlyen J, Tai S, ~~Killaspy H, Osborn D, Popelyuk D,~~ et al. A systematic review of mental disorder, suicide, and deliberate self harm in lesbian, gay and bisexual people. *BMC Psychiatry* 2008;**8**(1):70.

~~18. Boehmer U, Miao X, Linkletter C, Clark MA. Adult health behaviors over the life course by sexual orientation. *American Journal of Public Health* 2012;**102**(2):292-300.~~

~~19. Keogh P, Reid D, Bourne A, Weatherburn P, Hickson F, Jessup K, et al. Wasted opportunities: Problematic alcohol and drug use among gay men and bisexual men. London: Sigma Research, 2009.~~

~~20. Corliss HL, Rosario M, Wypij D, Fisher LB, Austin SB. Sexual orientation disparities in longitudinal alcohol use patterns among adolescents findings from the Growing Up Today Study. *Archives of Pediatrics & Adolescent Medicine* 2008;**162**(11):1071-78.~~

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21. Case P, Austin SB, Hunter DJ, Manson JE, Malspeis S, Willett WC, et al. Sexual orientation, health risk factors, and physical functioning in the Nurses' Health Study II. *Journal of Womens Health* 2004;13(9):1033-47.

22. Chakraborty A, McManus S, Brugha TS, et al. Bebbington P, King M. Mental health of the non-heterosexual population of England. *British Journal of Psychiatry* 2011;198(2):143-48.

23. King M, McKeown E, Warner J, Ramsay A, Johnson K, Cort C, et al. Mental health and quality of life of gay men and lesbians in England and Wales - Controlled, cross-sectional study. *British Journal of Psychiatry* 2003;183:552-58.

40. Talley AE, Sher KJ, Littlefield AK. Sexual orientation and substance use trajectories in emerging adulthood. *Addiction* 2010;105:1235-45.

41. Boehmer U, Miao X, Linkletter C, et al. Adult health behaviors over the life course by sexual orientation. *Am J Public Health* 2012;102:292-300.

42. Ziyadeh NJ, Prokop LA, Fisher LB, Rosario M, Field AE, Camargo CA, Jr., et al. Sexual orientation, gender, and alcohol use in a cohort study of US adolescent girls and boys. *Drug and Alcohol Dependence* 2007;87(2-3):119-30.

25. Tucker JS, Ellickson PL, Klein DJ. Understanding differences in substance use among bisexual and heterosexual young women. *Womens Health Issues* 2008;18(5):387-98.

26. Marshal MP, Friedman MS, Stall R, King KM, Miles J, Gold MA, et al. Sexual orientation and adolescent substance use: a meta-analysis and methodological review. *Addiction* 2008;103(4):546-56.

27. Talley AE, Sher KJ, Littlefield AK. Sexual orientation and substance use trajectories in emerging adulthood. *Addiction* 2010;105(7):1235-45.

28. Lindley LL, Walsemann KM, Carter JW, Jr. The association of sexual orientation measures with young adults' health-related outcomes. *Am J Public Health* 2012;102:44.

Corliss H, Wadler B, Jun H J, et al. Sexual orientation disparities in cigarette smoking in a longitudinal cohort study of adolescents. *Nicotine Tob Res* 2013;15:213-22.

45. Blosnich J, Lee JG, Horn K. A systematic review of the aetiology of tobacco disparities for sexual minorities. *Tob Control* 2013;22:66-73.

46. Ryan H, Wortley PM, Easton A, et al. 6:1177-85.

29. Economic and Social Data Service. Longitudinal Study of Young People in England: Waves One to Seven. In: ESDS, editor. Colchester, 2011.

30. Smoking among lesbians, gays, and bisexuals: a review of the literature. *Am J Prev Med* 2001;21:142-9.

47. Gervais A, O'Loughlin J, Meshefedjian G, et al. Bancej C, Tremblay M. Milestones in the natural course of onset of cigarette use among adolescents. *CMAJ Canadian Medical Association Journal* 2006;175(3):255-61.

31. Brewster KL, Tillman KH. Sexual Orientation and Substance Use Among Adolescents and Young Adults. 48. Talley AE, Sher KJ, Steinley D, et al. Patterns of alcohol use and

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consequences among empirically derived sexual minority subgroups. *J Stud Alcohol Drugs* 2012;73:290-302.

49. Mitchell K, Wellings K, Elam G, et al. How can we facilitate reliable reporting in surveys of sexual behaviour? Evidence from qualitative research. *Cult Health Sex* 2007;9:519-31.

50. *American Journal of Public Health* 2012;102(6):1168-76.

32. Hatzenbuehler ML, Corbin WR, Fromme K. Trajectories and determinants of alcohol use among LGB young adults and their heterosexual peers: Results from a prospective study. *Dev Psychol/Developmental Psychology*. 2008;44(1):81-90.

33. Caldwell LL, Kivel BD, Smith EA, Hayes D. The leisure context of adolescents who are lesbian, gay male, bisexual and questioning their sexual identities: An exploratory study. *J Journal of Leisure Research*. 1998;30(3):341-55.

34. Udry JR, Chantala K. Risk assessment of adolescents with same-sex relationships. *J Adoles Journal of Adolescent Health* 2002;31(1):84-92.

5235. Eisenberg ME, Wechsler H. Social influences on substance-use behaviors of gay, lesbian, and bisexual college students: findings from a national study. *Soc Sci Med* 2003;57(10):1913-23.

5336. Collier KL, van Beusekom G, Bos HMW, et al/Sandfort TGM. Sexual Orientation and Gender Identity/Expression Related Peer Victimization in Adolescence: A Systematic Review of Associated Psychosocial and Health Outcomes. *J Journal of Sex Res Research*. 2013;50(3-4):299-317.

54. Smith EA, Malone RE. The outing of Philip Morris: advertising tobacco to gay men. *Am J Public Health* 2003;93:988-93.

5537. Aronsson H, Lind J, Ghirlanda S, et al/Enquist M. Parental influences on sexual preferences: The case of attraction to smoking. *Journal of Evolutionary Psychology* 2011;9(1):21-41.

38. Smith EA, Malone RE. The outing of Philip Morris: advertising tobacco to gay men. *Am J Public Health* 2003;93(6):988-93.

39. Needham BL. Sexual attraction and trajectories of mental health and substance use during the transition from adolescence to adulthood. *J Youth Adolesc* 2012;41(2):179-90.

40. Marshal MP, Friedman MS, Stall R, Thompson AL. Individual trajectories of substance use in lesbian, gay and bisexual youth and heterosexual youth. *Addiction* 2009;104(6):974-81.

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Table 1. Descriptive statistics for study variables (unweighted), according to sexual orientation identity in 2009, N(%)

Study variables (N = 7698) ^a	Lesbian or gay (n = 88, 1.1%)	Bisexual (n = 146, 1.9%)	Heterosexual (n = 7464, 97.0%)	p ^c	p ^d	p ^e
Female	33 (37.5)	111 (76.0)	3792 (50.8)	0.001	0.014	<0.001
Ethnic minority ^f	12 (13.6)	12 (8.2)	2112 (28.3)	<0.001	0.003	<0.001
Parental education (less than secondary)	13 (14.8)	26 (17.8)	1715 (23.0)	0.02	0.07	0.14
Parental occupation (routine or unemployed)	10 (11.4)	18 (12.3)	900 (12.1)	0.97	0.84	0.92
History of cigarette smoking (age 15/16)	35 (39.8)	60 (41.1)	1649 (22.1)	<0.001	<0.001	<0.001
Alcohol drinking >2 days/week (age 18/19)	33 (37.5)	38 (26.0)	1467 (19.7)	<0.001	<0.001	0.057
Risky single occasion drinking (age 18/19)	40 (45.5)	48 (32.9)	1985 (26.6)	<0.001	<0.001	0.090

^aAnalytic sample (N = 7698) comprises participants with available data on age, sex, ethnic group, parental education, occupational social class, smoking history and alcohol use. ^cp value for lesbian/gay/bisexual vs. heterosexual, ^dp value for gay/lesbian vs. heterosexual, ^ep bisexual vs. heterosexual. ^fUnweighted frequency (ethnic minority groups were over-sampled).

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Table 2. Association between sexual orientation identity and smoking, alcohol drinking >2 days/week and risky single occasion drinking

N=7698	History of cigarette smoking vs. non-smoker		Alcohol drinking >2 days/week vs. ≤2 days/week or never		>Weekly risky single occasion drinking vs. ≤weekly	
	Minimally adjusted ^b	Fully adjusted ^c	Minimally adjusted ^b	Fully adjusted ^c	Minimally adjusted ^b	Fully adjusted ^c
<i>Model 1</i>						
Lesbian or gay (vs. heterosexual)	2.34*** (1.50, 3.65)	2.23** (1.42, 3.51)	1.99*** (1.28, 3.09)	1.99** (1.25, 3.17)	1.82*** (1.16, 2.84)	1.80* (1.13, 2.86)
Bisexual (vs. heterosexual)	1.94*** (1.37, 2.75)	1.84** (1.30, 2.61)	1.26 (0.84, 1.89)	1.20 (0.79, 1.81)	1.11 (0.76, 1.61)	1.04 (0.71, 2.86)
<i>Model 2</i>						
Lesbian, gay or bisexual (vs. heterosexual)	2.08*** (1.57, 2.76)	1.98*** (1.49, 2.63)	1.53*** (1.15, 2.03)	1.48* (1.10, 1.99)	1.35* (1.01, 1.79)	1.29 (0.96, 1.74)

Values shown are odds ratios (95% confidence intervals). *** = p < 0.001, ** = p < 0.01, * = p < 0.05. ^aAnalytic sample (comprises participants with available data on age, sex, ethnic group, parental education and occupational social class, smoking and alcohol use. Sample weights are applied. ^bAdjusted for age and sex. ^cAdjusted for age, sex, ethnic minority status, parental educational attainment, parental occupational social class.

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Table S1. Association between sexual orientation identity and smoking, alcohol drinking >2 days/week and risky single occasion drinking

	History of cigarette smoking vs. non-smoker		Alcohol drinking >2 days/week vs. ≤2 days/week or never		>Weekly risky single occasion drinking vs. ≤weekly	
	Minimally adjusted ^b	Fully adjusted ^c	Minimally adjusted ^b	Fully adjusted ^c	Minimally adjusted ^b	Fully adjusted ^c
<i>Males (n = 3762)</i>						
Gay (vs. heterosexual)	2.38** (1.31, 4.33)	2.31** (1.27, 4.20)	1.92* (1.10, 3.35)	1.95* (1.07, 3.55)	2.13* (1.21, 3.77)	2.15* (1.19, 3.87)
Bisexual (vs. heterosexual)	1.93 (0.92, 4.09)	1.88 (0.88, 4.00)	1.04 (0.49, 2.20)	0.95 (0.44, 2.07)	0.67 (0.30, 1.46)	0.61 (0.27, 1.36)
<i>Females (n = 3936)</i>						
Gay (vs. heterosexual)	2.30* (1.14, 4.62)	2.14* (1.04, 4.38)	2.10 (1.00, 4.42)	2.06 (0.84, 2.15)	1.40 (0.68, 2.88)	1.34 (0.63, 2.86)
Bisexual (vs. heterosexual)	1.93** (1.30, 2.87)	1.82* (1.23, 2.69)	1.39 (0.87, 2.21)	1.35 (0.84, 2.15)	1.32 (0.87, 2.00)	1.26 (0.82, 1.94)

Values shown are odds ratios (95% confidence intervals). *** = $p < 0.001$, ** = $p < 0.01$, * = $p < 0.05$. ^aAnalytic sample (comprises participants with available data on age, sex, ethnic group, parental education and occupational social class, smoking and alcohol use. Sample weights are applied.

^bAdjusted for age. ^cAdjusted for age, ethnic minority status, parental educational attainment, parental occupational social class.

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STROBE Statement—Checklist of items that should be included in reports of *cohort studies*

	Item No	Page No	Recommendation
Title and abstract	1	1	(a) Indicate the study’s design with a commonly used term in the title or the abstract
		2	(b) Provide in the abstract an informative and balanced summary of what was done and what was found
Introduction			
Background/rationale	2	5	Explain the scientific background and rationale for the investigation being reported
Objectives	3	6	State specific objectives, including any prespecified hypotheses
Methods			
Study design	4	6	Present key elements of study design early in the paper
Setting	5		Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
Participants	6	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up
		N/A	(b) For matched studies, give matching criteria and number of exposed and unexposed
Variables	7	6-8	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
Data sources/ measurement	8*	6-8	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group
Bias	9	8	Describe any efforts to address potential sources of bias
Study size	10	9	Explain how the study size was arrived at
Quantitative variables	11	6-8	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods	12	8	(a) Describe all statistical methods, including those used to control for confounding
		8-9	(b) Describe any methods used to examine subgroups and interactions
		9	(c) Explain how missing data were addressed
		9	(d) If applicable, explain how loss to follow-up was addressed
		9	(e) Describe any sensitivity analyses
Results			
Participants	13*	9	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed
		9	(b) Give reasons for non-participation at each stage
		N/A	(c) Consider use of a flow diagram
Descriptive data	14*	9	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders
		9	(b) Indicate number of participants with missing data for each variable of interest
		N/A	(c) Summarise follow-up time (eg, average and total amount)
Outcome data	15*	9, 21	Report numbers of outcome events or summary measures over time
Main results	16	22	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear

			which confounders were adjusted for and why they were included
		N/A	(b) Report category boundaries when continuous variables were categorized
		N/A	(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17	24	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses
Discussion			
Key results	18	11	Summarise key results with reference to study objectives
Limitations	19		Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
Interpretation	20	12	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
Generalisability	21	12,13	Discuss the generalisability (external validity) of the study results
Other information			
Funding	22	N/A	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at <http://www.strobe-statement.org>.